HEATING & VENTILATING

For Engineers and Contractors Controlling the Design, Specification, Installation and Maintenance of Heating, Ventilating and Air Conditioning

Volume 33 | MAY, 1936 | Number 5

CONTENTS

How to Solve Problems Involving Moisture on Windows	*Clifford Strock*	27
Heat Gain from Artificial Lights		30
HEATING & VENTILATING'S DEGREE-DAY COMPETITION		31
Winter Air Conditioning in Hospital Operating Rooms		32
Seasonality of Summer Air Conditioning	*Knight C. Porter*	34
Estimating Heat Load in Mild Climates	*J. A. Robinson*	36
Economic Benefits of Air Conditioning		37
The Flow of Air in Ducts	*Emory Kemler*	38
Air Conditioning Improves Plate Making and Offset Printing		41
Report of Twelfth Oil Burner Show		42
Getting Down to Fundamentals — Part 12		43
Degree-Day Chart Shows Why Bills Vary		46
Research Rates Effect of Atmospheric Conditions		46
Automatic Controls for Year 'Round Central Fan Systems		47
Thermostatic Radiator Valves Modernize Insurance Buildings		50
Apartment House Installs Year 'Round Conditioning	*Joseph F. Kern, Jr.*	51
Electrical Heat for Seattle Homes		54
Air Conditioning Aids Utility Employes	*Leslie S. Tarleton*	55
Sun Heat Greatest on Mountains		56
Cross Connecting Two Unit Conditioners Permits Flexibility		57
What Readers Say		58
Heating Business in February 73.3% of 1929		60
Setting Dampers for Split System Control	*E. O. Young and Francis A. Westbrook*	61
Fuel Costs Cut 20% by Storm Windows and Doors		62
Reference Data, 77 and 78	Opposite	62
Heating a Village from Diesel Exhaust		63
Birmingham Reports Half of Its Families Use Furnaces		64
Editorials		65
Abstracts		66
News of the Month		67
New Equipment		70
Degree-Days for March, 1936		72
The Weather for March, 1936		74
New Catalogs		77
With the Manufacturers		79

Published Monthly by

THE INDUSTRIAL PRESS, 148 LAFAYETTE STREET, NEW YORK

WESTERN OFFICE: 228 NORTH LA SALLE ST., CHICAGO

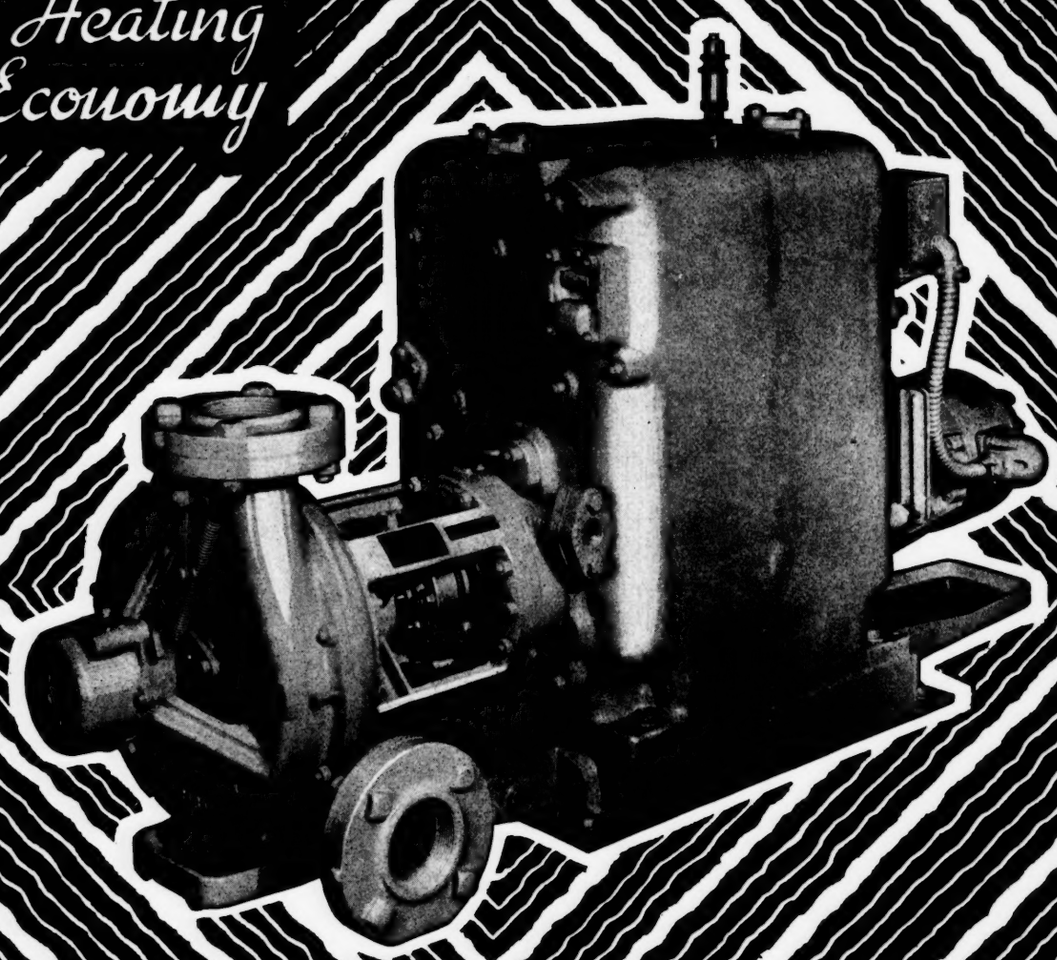
ROBERT B. LUCHARS, President
EDGAR A. BECKER, Vice-Pres. and Treasurer
ERIK OBERG, Secretary

C. H. B. HOTCHKISS, Editor
CLIFFORD STROCK, Associate Editor
JOSEPH F. KERN, Jr., Assistant Editor

Member of A.B.C. and A.B.P.

Subscription, $2 per year in United States and Mexico. $2.50 in Canada. $3 all other countries. Single copies regular issue, 30 cents.

Centralized Heating Economy



A RETURN LINE VACUUM PUMP THAT CUTS HEATING COST.

This unusual pump needs no electric current, cutting out greatest item of pump operating expense.

More important, this pump insures absolutely uniform circulation in system. That means continuous steam economy.

Simple, compact, one moving element, no wearing parts, no internal lubrication. Bulletin No. 203 gives the facts. Your copy is waiting.

THE NASH ENGINEERING COMPANY
SOUTH NORWALK, CONNECTICUT, U. S. A.

How to Solve Problems Involving Moisture on Windows

By CLIFFORD STROCK†

FREQUENTLY in designing heating and air conditioning systems it is desired to determine the conditions under which moisture or frost will be deposited on the inside of glass windows. This problem is met with increasing frequency due to the growing popularity of air conditioning, and the trend toward humidification. The problem may be one in which the designer expects to carry a given relative humidity and, knowing the inside temperature, wishes to find how far the outside temperature can drop before moisture will be present on the window. In other cases, knowing the inside temperature and the lowest outside temperatures encountered, the designer wants to know what relative humidity can be carried inside without moisture deposition.

Before proceeding we can inquire as to just what causes moisture to deposit on the window. The answer is that air contains at least some moisture present in the form of steam and, when such air strikes a much colder surface, such as a glass window, it is condensed on that surface, provided the glass surface is cold enough to chill the air below its dewpoint.

The dewpoint of the air is that temperature at which air of a given relative humidity and temperature will condense out its moisture when the air is cooled. If the conditions of the air are such, then, that the air temperature will fall below the dewpoint when it strikes the window of a certain temperature, condensation will appear on the window. Obviously, then, a relatively warm window will not condense out moisture as readily as a cold one, and it follows that for a window to be relatively warm it must have less heat flow than one which is colder, other things being equal. Thus, one way of avoiding moisture deposit on windows would be to have windows with a low heat transmission.

Since this condensation depends also on the dewpoint we can see that if we take relatively dry air—that is, with a low relative humidity—we stand less chance of having moisture deposited when striking a cold surface than if we have a relatively moist air.

Since for a given relative humidity and inside temperature the dewpoint is fixed, it is easy to determine exactly how cold the inside surface of the glass must be in order to have moisture deposited. Moisture will be deposited as soon as this dewpoint is reached. The problem is, then, in a specific case, to determine what the inside temperature of the glass window is.

Tests have indicated that this surface temperature is a percentage of the total difference in temperature between inside and outside air, and is constant for a particular type window. For example, with a double window with wind on the outside, the inside glass surface temperature is always about 30% of the difference between the inside and outside temperature. If the difference between the inside and outside of the building were 80°, then the temperature of the glass would be 30% x 80°, or 24° lower than the inside temperature. The figure 30% in this case is the constant (R) for single windows with wind on the outside.

However, the value of R fluctuates with the type of window so that the need for determining these constants has been felt for some time. Consequently, with this in view, experiments were conducted at the University of Michigan under a project sponsored by the Technical Committee of the Metal Window Institute. Results of the tests were described recently before the American Society of Heating and Ventilating Engineers[1].

The constant, or ratio R, which is the per cent of difference between the room surface temperature of the glass and the temperature difference between inside and outside, is expressed in the following equation:

$$R = \frac{t_r - t_g}{t_r - t_o} =$$

$$\frac{\text{room temperature} - \text{temperature room side of glass}}{\text{room temperature} - \text{temperature of outside air}}$$

where

t_r = room temperature, t_o = outside temperature, and
t_g = inside surface temperature of window.

Approximate values of R, based on the tests referred to, appear in Table 3.

The formula

$$R = \frac{t_r - t_g}{t_r - t_o}$$

may be written as

$$t_o = t_r - \frac{t_r - t_g}{R}$$

Thus we can find the outside temperature at which moisture will deposit on the window if we substitute the dewpoint temperature for our given inside conditions for the temperature of the glass t_g. For example:

Problem: At what outside temperature with wind will moisture begin to appear on the glass of a single window when the inside temperature is 70° and the relative humidity is 50%?

Solution: From Table 3 we find that for single windows with wind the value of R is 67%. From a psychrometric chart or from the third column of Table 1 we find that the dewpoint for 70° air and 50% relative humidity is 50°, which would be the given temperature at which moisture would appear. Substituting these values in the preceding equation we find t_o, or the out-

†Associate Editor, HEATING & VENTILATING.

[1]In a paper entitled "Room Surface Temperature of Glass in Windows," by Prof. J. E. Emswiler, University of Michigan, and W. C. Randall, chief engineer, Detroit Steel Products Co.

TABLE 1.—OUTSIDE TEMPERATURES AT WHICH MOISTURE WILL DEPOSIT ON VARIOUS TYPE WINDOWS FOR DIFFERENT INSIDE TEMPERATURES AND RELATIVE HUMIDITIES

Inside Temperature, °F.	Inside Relative Humidity, %	Inside Dewpoint, °F.	Outside Temperature At Which Moisture Will Deposit—°F			
			Single Windows		Double Windows	
			Still Air	Wind	Still Air	Wind
60	10	6	**—48**	**—21**	**—156**	**—120**
	20	20	**—20**	**0**	**—100**	**—73**
	30	29	**—2**	**14**	**—64**	**—43**
	40	36	12	24	—36	—20
	50	41	22	31	—16	—3
	60	46	32	39	4	13
	70	50	40	45	20	27
	80	54	48	51	36	40
	90	57	54	55	48	50
	100	60	60	60	60	60
65	10	10	**—45**	**—17**	**—155**	**—118**
	20	24	**—17**	**4**	**—99**	**—72**
	30	33	1	17	—63	—41
	40	40	15	28	—35	—18
	50	46	27	37	—11	2
	60	51	37	44	9	18
	70	55	45	50	25	31
	80	59	53	56	41	45
	90	62	59	60	53	55
	100	65	65	65	65	65
70	10	13	**—44**	**—15**	**—158**	**—120**
	20	28	**—14**	**7**	**—98**	**—70**
	30	37	4	20	—62	—40
	40	45	20	33	—30	—13
	50	50	30	40	—10	3
	60	55	40	48	10	20
	70	60	50	55	30	37
	80	64	58	61	46	50
	90	67	64	65	58	60
	100	70	70	70	70	70
75	10	16	**—43**	**—14**	**—161**	**—122**
	20	31	**—13**	**9**	**—101**	**—72**
	30	41	7	24	—61	—38
	40	49	23	36	—29	—11
	50	55	35	45	—5	8
	60	60	45	53	15	25
	70	65	55	60	35	42
	80	68	61	65	47	52
	90	72	69	70	63	65
	100	75	75	75	75	75
80	10	20	**—40**	**—10**	**—160**	**—120**
	20	35	—10	13	—100	—70
	30	46	12	29	—56	—33
	40	53	26	40	—28	—10
	50	60	40	50	0	13
	60	65	50	58	20	30
	70	69	58	64	36	43
	80	73	66	70	52	57
	90	77	74	75	68	70
	100	80	80	80	80	80

NOTE: If the answer, appearing in any of the last four columns, is printed in bold-face type, the dewpoint temperature is below 32° and the condensation on the window will be in the form of frost.

side temperature, to be approximately 40°.

Table 1 gives the solution for this equation for a wide range of conditions, so that it is unnecessary to go to the trouble of substituting in the formula.

The equation may also be rewritten as

$$t_g = R(t_o - t_r) + t_r$$

so that we can solve for the glass temperature (and, thus the dewpoint at which moisture will appear for given outside temperatures and inside conditions). Table 2 is based on this formula and gives the inside relative humidity with dewpoints such as to cause deposition for given conditions.

How to Use Tables 1 and 2

The following examples will make clear the use of Tables 1 and 2.

Example: In a room with a temperature of 70° and a relative humidity of 50% and with single windows, at what outside temperature with wind will moisture be deposited on the window?

TABLE 2.—RELATIVE HUMIDITY IN BUILDINGS AT WHICH MOISTURE WILL DEPOSIT ON VARIOUS TYPE WINDOWS FOR DIFFERENT INSIDE AND OUTSIDE TEMPERATURES

Inside Temperature, °F.	Outside Temperature, °F.	Inside Relative Humidity (%) At Which Moisture Will Deposit			
		Single Windows		Double Windows	
		Still Air	Wind	Still Air	Wind
60	—50	**9**	**4**	34	**28**
	—40	**12**	**5**	38	**32**
	—30	**16**	**7**	42	36
	—20	**20**	**10**	47	41
	—10	**25**	**14**	52	46
	0	**32**	**20**	57	52
	10	39	**28**	62	58
	20	47	36	69	65
	30	57	48	76	72
	40	70	62	84	80
65	—50	**9**	**3**	34	**26**
	—40	**12**	**4**	38	30
	—30	**14**	**6**	42	34
	—20	**18**	**9**	46	39
	—10	**23**	**13**	50	45
	0	29	**18**	55	49
	10	36	**24**	60	56
	20	43	32	66	63
	30	52	41	73	70
	40	63	54	80	78
70	—50	**9**	**3**	34	26
	—40	**11**	**4**	36	30
	—30	**14**	**6**	41	34
	—20	**18**	**9**	46	38
	—10	**22**	**12**	49	42
	0	27	**16**	55	47
	10	33	**22**	59	53
	20	40	30	63	59
	30	50	38	71	66
	40	60	49	79	73
75	—50	**8**	**3**	33	26
	—40	**10**	**4**	36	29
	—30	**13**	**6**	40	32
	—20	**17**	**8**	44	35
	—10	21	**11**	48	42
	0	25	**15**	52	46
	10	31	**20**	57	52
	20	37	26	62	58
	30	45	34	68	64
	40	53	43	74	70
80	—50	**8**	**2**	32	25
	—40	**10**	**3**	35	28
	—30	**13**	**5**	38	31
	—20	**16**	**7**	42	35
	—10	20	**10**	46	39
	0	24	**13**	50	44
	10	29	18	54	49
	20	35	24	59	54
	30	42	30	65	60
	40	50	40	71	67

NOTE: If the answer, appearing in any of the last four columns, is printed in bold-face type, the dewpoint temperature falls below 32° and the condensation on the window will be in the form of frost.

Solution: Referring to Table 1, find the figure 50 in the second column of the division marked "70°" in the first column. In the fifth column, which relates to single windows with wind, we find that moisture will be deposited at 40°.

Example: With a room temperature of 65°, a relative humidity of 20%, and with single windows in wind, at what outside temperature will moisture be deposited?

Solution: Referring to Table 1, find the figure 20 in the second column in the second division of figures opposite 65° in the first column. Referring to the fifth column we find the answer to be 4°. Since this figure appears in bold face type it indicates that the temper-

TABLE 3.—VALUES OF *R* FOR GLASS FOR GENERAL WINDOW TYPES

(As reported by Emswiler and Randall before the ASHVE)

General Type of Window	Wind Condition	*R* For Glass In Per Cent (Approx.)
Single windows	With wind	67
Double windows	With wind	30
Single windows	Still air	50
Double windows	Still air	25

ature of the inside surface of the glass is below 32°, and that consequently the moisture will be deposited in the form of frost.

Example: Given a room temperature of 70° in a locality where the lowest outside temperature reached is 10° below zero. With a double window in still air what relative humidity can be carried in the room during the coldest weather before moisture is deposited on the window?

Solution: Find the figure — 10 in the second column of Table 2 opposite the figure 70 in the first column. In the fifth column, opposite the — 10, we find that 49% relative humidity will give us moisture deposition, so that any humidity less than this will not give us moisture on the window.

Example: With a room temperature of 75° and with the expectation of zero weather outside, what relative humidity can be carried before moisture is deposited on a single window with wind?

Solution: Referring to Table 2, find the figure 0 in the second column opposite 75° in the first column. In the fourth column we find the answer to be 15%. Since the figure 15 appears in bold face type it indicates that for 15% relative humidity or more, under the given conditions, the moisture will be deposited in the form of frost.

Heat Gain from Artificial Lights

IT is a recognized fact that artificial light generates heat as well as light. In the past this has been of little consequence so far as heating effect on a building is concerned. But with the trend toward higher wattage capacities in illuminating interiors, which generate a corresponding larger amount of heat, and the trend toward artificial cooling systems for greater summer comfort, more consideration must tbe given in the future to the heat generated by the lighting system.

A gas-filled incandescent lamp operated at normal voltage distributes energy about as follows: light, 11%; heat, as invisible radiation in the infra-red region, 70%; heat conducted away through the supports and leads, 3%; heat dissipated by gas convection and conduction, 8%, and heat radiated by the bulb, 8%. Thus, from a clear bulb, gas-filled lamp, about 90% of the total energy is in radiant form. This will increase the feeling of warmth to the human body by its radiant effect, although its radiant energy will not be effective in raising the temperature of the interior of the lamp until it has been intercepted by an absorbing surface which in turn dissipates the heat by convection. As far as the lighting equipment is concerned, the amount of radiant energy intercepted by it depends upon its type.

The first thing is to determine what proportion of the lighting system's energy is actually effective, and second, how to get rid of it. Much of it is radiant energy and radiant energy is hard to control. It must be changed to some other form of energy in order to make control effective. The conclusion, therefore, is that the amount of heat from the lighting system that has an effect on the cooling system varies between 50% and 90%. A safe figure would be 50% in the majority of cases. The temperature rises with the increase in wattage per square foot.

Radiant heat which comes from a lighting unit or is re-radiated from the walls or ceiling is instantaneously effective in producing a feeling of warmth. Its effect can be counteracted by maintaining a lower air temperature in a building which is artificially cooled. Not all of the radiant heat coming from the lamps becomes a load on the cooling system, however. A part passes through the windows to outdoors, and some is absorbed by the building through the walls, ceiling, and floor and is dissipated during the cooler night hours, the ceiling height having an important bearing upon this matter.

With the lighting load at four watts per square foot, over a 7-hr. period, the temperature rise would be about 3°, having doors and windows closed, and a regular cooling system. We would have to figure on taking care of this heat from the lighting system, but we would only be concerned with it for three months in the year in Boston, as an example.

With 16 to 20 watts of light per square foot, the temperature rise would be 14° to 16°, and then there would be complaints. In some cases we can make use of a false ceiling, open to the top light units, with an air intake on one side and an exhaust fan on the other side of the false ceiling.

But 90% of the heat from a lighting system is radiant energy. We find that the lighting unit absorbs only about 25% of the heat by the use of absorbent glass under or covering the light unit, the balance being directed below and not horizontally through the false ceiling. Thus, 65% of the radiant energy goes down toward the floor. Cooling is then effected by forcing air through the false ceiling intake and across to the exhaust at the rate of 400 c.f.m.

Changing radiant energy to controllable energy could take care of a maximum of 60%. With water cooled lamps, such as are used in some motion picture studios, we could transfer about 75% of the radiant energy. With heat absorbing glass at least twice as much heat can be removed by the ventilating air as is possible from the usual types of suspended lighting units. In winter, this heat could be utilized for an upper floor, being forced outdoors in summer. The best solution of the problem on lights is extra cooling capacity when the amount of radiant heat is only 50%. But at 15 to 20 watts per square foot, we should use heat absorbing glass and force out the extra heat by exhaust.

—Abstracted from an address by Walter Sturrock, Illuminating Engineer, General Electric Co., before a joint meeting of the Air Conditioning Bureau of Boston and the Illuminating Engineering Society.

Announcing

HEATING & VENTILATING'S

DEGREE-DAY COMPETITION

We announce a DEGREE-DAY COMPETITION open to everyone under the rules at the bottom of this page. You don't have to be a successful or famous author, or even one of the so-called "experts" in order to enter this competition.

The idea is to send us a short, concise story of how you have made use of this unit in your own work. Tell your experiences with it. Describe what you have done. Maybe you have introduced modifications and variations of your own—if so, that's all right—just include them too. Any interesting or constructive ideas, it makes no difference what, just so they have to do with the Degree-Day and its use.

It is now over ten years since the Degree-Day unit appeared. HEATING & VENTILATING is proud of its part in bringing this unit to the attention of the industry, and of the fact that it has published Degree-Day figures for your use for almost nine years. We feel a responsibility for helping our friends and readers make the best possible use of the Degree-Day.

We know from correspondence of the wide interest in this unit. We know that all the uses haven't been described. You'll be helping others by sending in your story. Also you'll be helping yourself because of the generous cash awards. Your story need take only a little of your time—the shortest has equal chance with the longest manuscript. Read the rules below and send in your story now. At any rate be sure to get it to us before the closing date.

FIRST PRIZE . . .	**$100**
Second Prize . . .	**30**
Third Prize	**15**
Fourth Prize . . .	**10**
Fifth Prize	**5**

RULES OF THE COMPETITION

1.—Write an original story for exclusive publication in HEATING & VENTILATING covering any one or all of the following subjects—(a) How you use Degree-Day data in your business; (b) Your experience with the Degree-Day; (c) Results of using the Degree-Day. This is interpreted to mean that a manuscript is eligible if on any phase of the Degree-Day or its use.

2.—Typewrite your manuscript neatly on one side of paper only. Include any forms used together with an explanation of them. If curves, charts, or tables are regularly used in connection with the Degree-Day, enclose a copy of them and refer to their use in your story. Such curves, charts, etc., need not be done in ink but must be legible.

3.—Enclose the original typewritten manuscript in the same envelope with a letter written on your own or your firm's business letterhead and signed by you. Do not put your name on the manuscript itself.

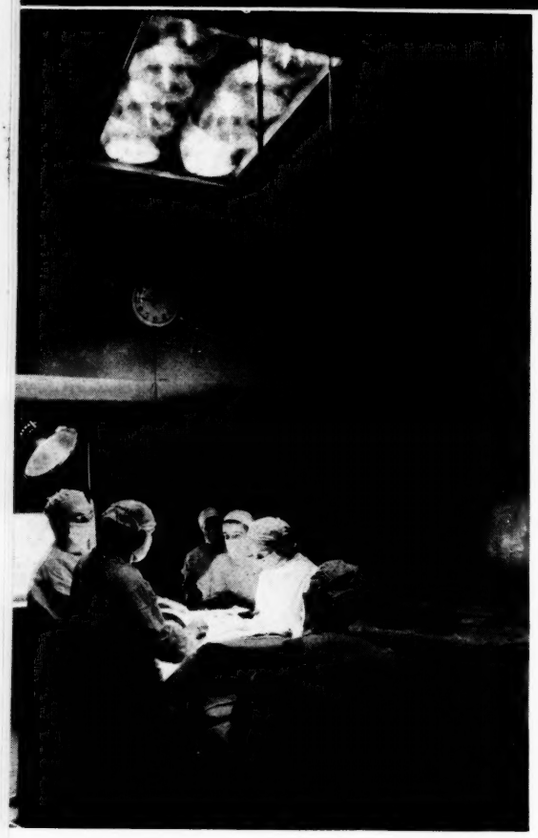
4.—Judges of the competition will consist of Eugene D. Milener, Secretary, Industrial Gas Section, American Gas Association, who originated the Degree-Day method, and the editors of HEATING & VENTILATING. Decision of the judges is final. Literary merit will be considered, but principal consideration will be given to originality displayed, and to simplicity and general usefulness to others of the application described in the story. No manuscript of more than 3,000 words, or one estimated to require more than four pages in HEATING & VENTILATING, will be considered. No entries returned. Submit one entry only.

5.—Competition is open to any one actively engaged in heating, ventilating, piping, or air conditioning work in the United States and Canada, including employes of utility companies, railroads, industrial companies, fuel producing or distributing companies, as well as to independent contractors or engineers or their employes. Entries will not be considered if coming from professional writers, correspondents, or employes of publishers.

6.—Manuscripts submitted are with the understanding that whether or not they receive a prize in this competition, they are for possible use in regular or special issues of HEATING & VENTILATING or other publications of The Industrial Press.

7.—Winners of the competition will be announced in the August, 1936, issue of HEATING & VENTILATING. Competition closes June 30, 1936, and all entries must be postmarked before midnight of that date.

8.—Mail entry to Degree-Day Competition, HEATING & VENTILATING, 148 Lafayette St., New York, N. Y.



(Left) A group of medical students and interns in a viewing gallery watching an operation being performed. (Below) One of the operating rooms. An accurate control of the humidity is necessary to prevent explosions of the anesthetics.

Modern Hospital Uses Winter Air Conditioning in Operating Rooms

ONE of the finest examples of a well designed hospital is the Robinson Memorial Hospital recently completed in Boston. The hospital, the largest unit of a group of eight known as the Massachusetts Memorial Hospitals, has eight floors of brick, steel, and concrete fireproof construction with a total floor area of about 24,000 sq. ft. It was constructed by the John Bowen Company from plans by Kendall, Taylor & Company at an approximate cost of $300,000. The engineering designs were by Richard D. Kimball Company.

Of unusual interest are the operating rooms, of which there are six, four regular, one for orthopedic cases, and one for obstetrical cases. The four regular operating rooms are located on the seventh floor and each has a viewing gallery for medical students and interns on the eighth floor. Unlike the amphitheater type of operating rooms, these are constructed so that only the actual participants are in the room, making it impossible for alien germs to enter. The viewing galleries are all alike, with a series of heavy plate glass windows set at an angle slightly above the horizontal to enable the spectators to look down onto the operating table.

Above the operating tables are microphones through which the operating surgeon explains the various steps as he goes along, his voice being carried by an amplifier to the students above. Should they wish to ask questions, these are written on slips of paper which drop through a chute to the operating room, where they are picked up by a nurse who reads them to the chief surgeon, he replying through the mike.

Electric switches and all other electric fixtures in the operating rooms are protected to prevent entrance of sparks that might explode gases given off by the various mixtures used during an operation for anesthetics and other purposes. All electric outlets are doubled so that in case power fails on the hospital's own lines, an immediate switch is made automatically to Edison power, connected for emergency use. Each room is equipped with an amphitheater operating light that can be focussed, by means of a long turn screw with handle close to the surgeon's hand, on any part of the patient's body without casting a shadow. These lights have color correction, with eight 100-watt lamps.

Each operating room, instead of a water sterilizer, has a thermostatically controlled solution cabinet maintained at 99°-100° in which are kept glucose, saline solutions, and distilled water in flasks. All through the building each floor has similar cabinets, to have solutions ready for the doctors at the correct temperature at all times.

During the winter the air entering the operating rooms is heated, humidified, and cleaned. The conditioning equipment is located in a metal penthouse on the roof. Outside air is drawn in through a preheater, heated to about 40°, and then passed through an air washer and eliminator plates to a fan. After leaving

the fan it is passed through two heating coils and enters the main distributing duct at about 130°.

A control valve in the steam line supplying the preheater is actuated by a thermostat located behind the baffle plates in such a manner that a humidity of about 55% is maintained in the operating rooms. The humidity is maintained at this point throughout the year primarily as a safety device. If the humidity falls below 54% there is a possibility that some of the gases used as anesthetics might explode. To prevent the condensing of moisture on the windows during the cold winter months all of the windows are set with double glass.

A thermostat in each room operates mixing dampers so as to regulate the amount of warm air entering. No radiators are used in these rooms, all the heat being supplied by the air. An exhaust fan constantly takes out at the floor level as much air as enters at the ceiling, giving approximately eight changes each hour. No grilles are used in the operating rooms, the ducts being kept open to prevent any dust from collecting and to make them easier to clean.

The viewing galleries are heated and ventilated by means of grilles placed at the end of the rooms. Mixing dampers admit some cold air since a lower temperature is maintained in these rooms and since practically all the heat from the lamps in the operating rooms enters the viewing galleries.

Just outside the operating rooms are scrubbing-up rooms, where the surgeons prepare themselves for the operation. It is unnecessary for them to touch anything that would transmit infection. They push a lever with their feet and antiseptic soap is poured on their hands. A glass partition enables them to see what is going on in the operating room while they are preparing.

Besides the operating rooms, there are rooms for premature babies, offices and nurses' rooms, workrooms for preparing dressings, sterilizing rooms, solution rooms, as well as a number of private and semi-private wards.

In the preparation rooms there are constant temperature chambers for solutions and the warming of blankets. Workers in these rooms make dressings which are touched by no other hands until used in the operating rooms. The dressings when ready are pushed into a wall container which opens from the hall into the operating room. No outsider is allowed in the preparation room while the dressings are being made.

In certain of the workrooms a special direct indirect heating and ventilating system is used, air coming in through grilles set in the outside walls and passing through filters and then over concealed radiators under the windows. This system also has automatic control. Glass wool filters are used for cleaning the outdoor air in the workrooms.

All the rooms except the operating rooms, offices, and viewing galleries have concealed radiators of the copper fin type, with flush grilles. Cool air enters a grille near the floor, passes over the radiator, and goes back into the room through a grille about 3½ ft. above the floor. Each radiator has a disc with an orifice that governs the amount of steam required.

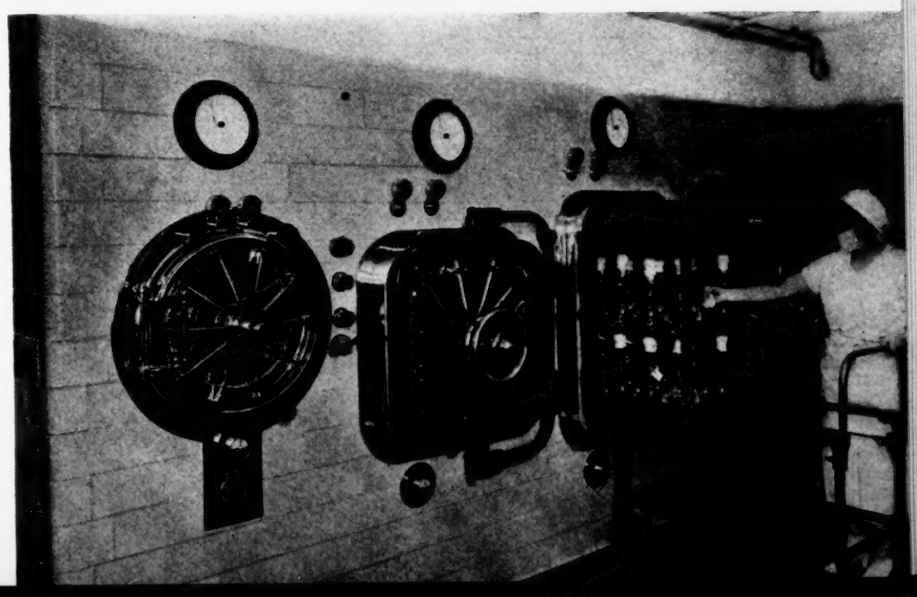
The room for premature babies is a sort of incubator with a very simple method of heating and humidifying —warm air passing over a pan of water placed on a concealed but accessible radiator. The temperature here can be brought up as high as 95° and is controlled by a thermostat.

Sterilizing equipment uses steam reduced to 15 lb. from 60 lb. Sterilizing closets have steel inner and outer jackets, a valve letting in live steam to the inner jacket, heating the contents to 250°. Special colored dial thermometers show whether or not sterilizing is going on at the correct heat. There are also recording thermometers with disc cards that are changed every 24 hr. and filed for permanent record.

The building, which is the last on the line from the central heating plant, located on another street, is heated by steam at 1-lb. pressure. There are three control valves in the basement operated by three thermostats; of these, one takes care of the space along the front wall of the building, another an exposed side wall, and the third the back wall. The fourth wall backs against another building and needs no thermostat, not being exposed. These thermostats modulate the supply of steam in the three zones to maintain temperatures at 72°-73°.

Twelve hundred feet of pipe were used from the central plant to the basements of the eight buildings, starting at 8 in. for two buildings and 6 in. for a large group of buildings. Steam leaves the central plant at 3 lb. to take care of the drop from there to the buildings supplied.

The hospital generates its own electricity at 220 volts d.c., carrying the entire load except for X-ray work, this latter coming on a.c. from the Edison Company. There is manual relay which can instantaneously throw the entire load over to Edison in case of accident. Out of 100 kw. maximum generated by the oil fired hospital plant, 60 hp. will eventually be used in the new building for lighting, elevator service, and other purposes.



One of the special sterilizing rooms which also has winter air conditioning. Steam at 15 lb. pressure is used for heating the cabinets to 250°, and special instruments are used to provide an accurate control of cabinet temperatures.

Seasonality of Summer Air Conditioning Business

By KNIGHT C. PORTER†

There have been available for general use few specific data relating to the seasonality of summer air conditioning business. The author, associated with a large electric utility company, presents some highly interesting figures on this subject. While his figures apply directly only to Chicago, it seems reasonable to believe that these figures may be fairly representative of other northern cities.

DISCUSSIONS of economic planning have focused attention upon the costs to society of unemployment resulting from seasonal business. The greatest industry confronted with this seasonal character was the automotive industry. We are all familiar with the efforts made to smooth-out the peaks of this industry in order to stabilize employment and improve efficiency. As yet it is too early to judge the value of this economic planning.

The air conditioning industry certainly is another industry which suffers from seasonal peaks and valleys. Almost any man on the street can tell you why this is so. He will immediately tell you that air conditioning is comfort cooling and therefore it can only be sold in anticipation of or during hot weather. Certainly anyone closely connected with the business knows the difficulty of closing contracts prior to March 15.

The record of Chicago sales over the last three years rather clearly shows this marked seasonal trend. Fig. 1 shows the slow spring rise and deep fall valley. However, it will be noticed that the curves from year to year have tended to flatten out with a somewhat better fall and winter business in the past two years. In 1933, 70% of the jobs were sold in three spring months; in 1934, 63%, and in 1935, only 50%. This is somewhat encouraging, but certainly does not yet represent an entirely desirable condition.

Fig. 2, which shows the horsepower contracted from month to month, presents quite a different curve. This graph tends to give a more accurate picture of the trend of dollar value of contracts awarded. Since major installations of 100 tons of refrigeration and more require several months for completion, such jobs are sold in the winter or early spring months. This explains the high values in Fig. 2 for early spring months. The curve is much more erratic than Fig. 1, because of the influence of a few very large installations. The curve does emphasize, however, the lack of air conditioning activity during the autumn.

Fig. 3 shows the sales of self-contained air conditioning units. Since most of these units are designed for room cooling and have no winter function, it is natural

TABLE 1.—PRELIMINARY SEASONAL INDEXES FOR SUMMER AIR CONDITIONING IN CHICAGO

Month	Number of Installations	Horsepower of Installations	Number of Room Units
January	3.2	8.3	0
February	4.7	8.5	0
March	6.2	11.8	0.8
April	10.5	13.1	5.3
May	18.2	16.0	16.2
June	17.8	9.5	15.9
July	20.8	8.7	37.1
August	11.2	4.3	21.2
September	3.1	9.6	3.5
October	0.9	2.1	0
November	1.2	2.3	0
December	2.2	5.8	0

†Air Conditioning Division, Commonwealth Edison Co., Chicago.

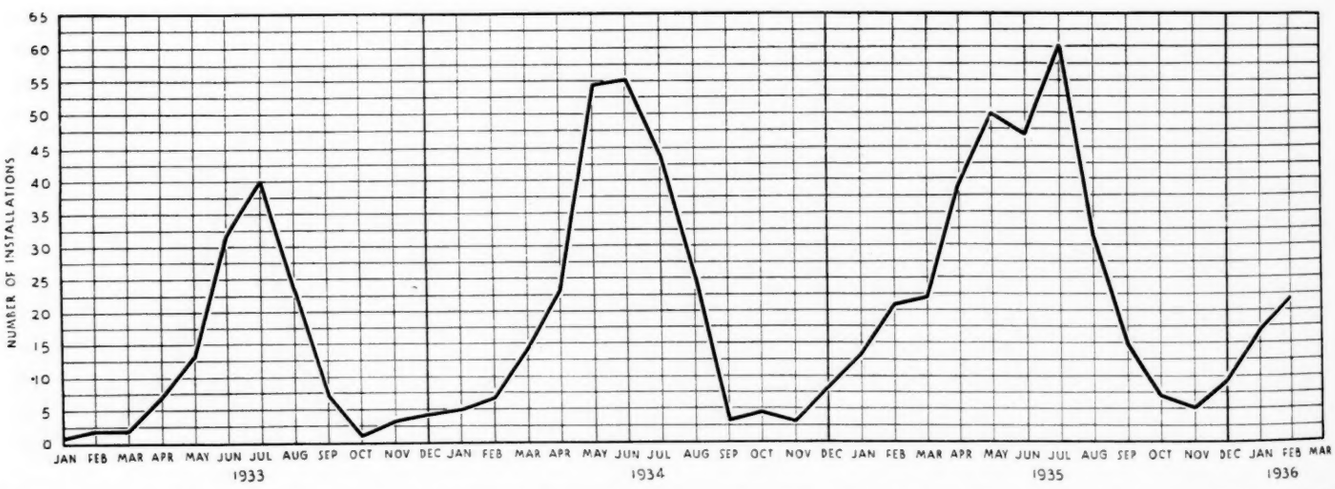


Fig. 1. Sales of summer air conditioning installations in Chicago by number of jobs. Note the sharp seasonality of this business. The figures apply to the month the jobs were contracted for, and not when they were sold.

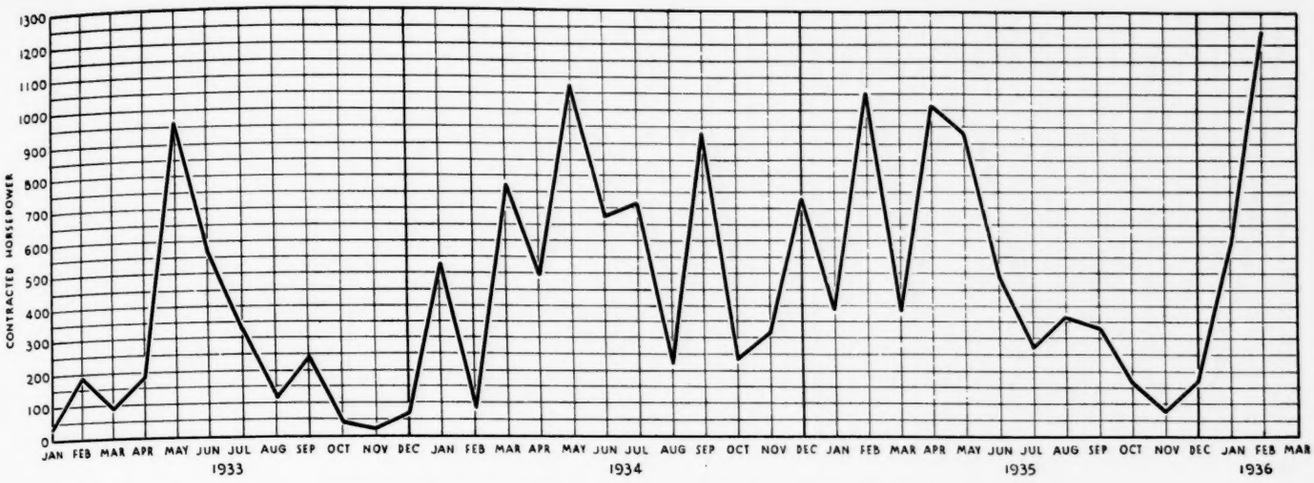


Fig. 2. Sales of summer air conditioning in Chicago by horsepower. The curve is irregular due to the influence of a few very large installations. This graph also emphasizes the lack of business in fall months.

that this curve should show such a distinct seasonal character. Note the delayed peak of the 1935 sales, occurring in July rather than June. This was due to the very cold May and June and the unusually warm July in Chicago.

From the data plotted in Figs. 1 to 3 it is possible to calculate the indexes of seasonal variation for summer air conditioning in Chicago. This information is tabulated in Table 1, and plotted graphically in Figs. 4 and 5. Table 1 is labeled "preliminary" since the figures are based on only a few years' record and may require revision when more complete information is available.

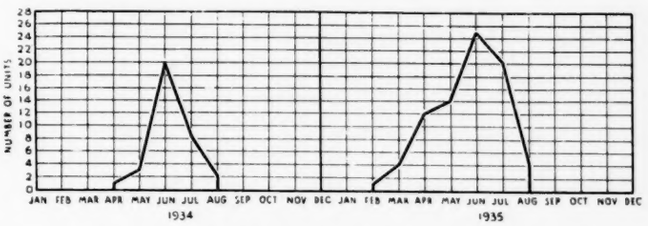


Fig. 3. Sales of self-contained air conditioning units in Chicago for two years

This problem of seasonality of sales is not alone the problem of the personal salesman. It is a distinct financial problem of manufacturers, distributors, contractors, design engineers, and erection crews. The spring bottle-neck is felt all along the line and is costly. How, then, may this situation be rectified?

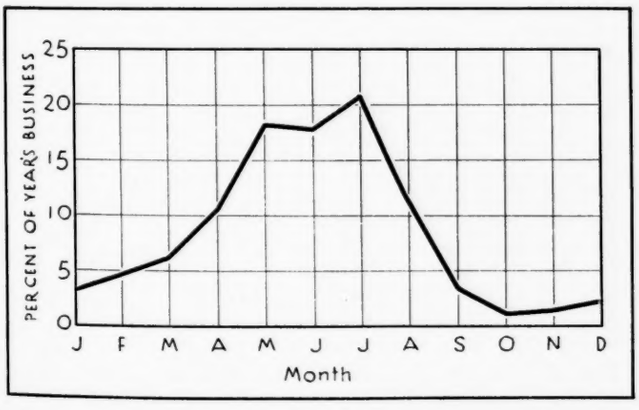
Fortunately, there are two sources through which self-adjustment may be expected:

1—*New Building.* In this case air conditioning sales will doubtless be consummated at the time other building contracts are assigned. In the case of new building, the installation of ducts, coils, fans, compressors, etc., will follow along in proper coordination with the progress of building, irrespective of season. Since we have had a badly subnormal new building activity, a return to normalcy will tend to flatten out our present seasonal curve.

2—*Large Installations.* The full importance of major installations requiring from six to ten months for completion has not yet been felt since relatively few such installations have been made in Chicago.

A soundly conceived forced planning can be hoped for. Because of the disadvantages of the present peak activity of the spring months which choke up the engineering departments, sales departments, and erection groups, it may be possible to offer inducements to fall purchase.

It is also possible that stronger selling of the winter values of air conditioning will carry the industry a long way toward a more favorable and more profitable year 'round activity.



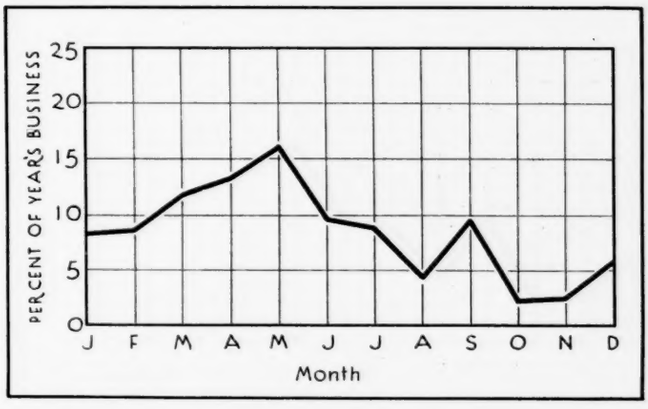


Fig. 4. (Left) and 5 (Right). Seasonal indexes of summer air conditioning sales for Chicago, based on records for slightly over three years. Fig. 4 applies to number *of installations, Fig. 5 to* size *(horsepower) of installations.*

Estimating Heat Load in Mild Climates

By J. A. ROBINSON†

The degree-day method for estimating building heat load as it varies with the weather has been found to be not particularly adapted to some mild climates—notably California. The author of this article, who has just completed an extended tour of this country, suggests as an alternate, a variation of this method for computing heat loads as used in Australia, which has a mild climate.

THE continent of Australia, approximating the United States in area, is located on the Tropic of Capricorn, between 10° and 45° South latitude. Being entirely surrounded by water, and subject to ocean currents particularly on the eastern and southern coasts, Australia possesses peculiar climatic conditions.

Generally speaking, the climate is temperate, and the temperature range between winter and summer over the entire continent does not exceed 80°. At Sydney, the largest city, the lowest temperature recorded was 37°, while the highest summer temperature was 103°. Melbourne, some 500 miles southwest of Sydney, has a range of from 33° to 105°.

The temperature difference which is used in Sydney for design purposes in estimating the heating load of a structure is only 30°. In general, therefore, the heating requirements in this city are somewhat similar to those of some of the cities located in the southern portion of the United States.

Heat Load Analysis

The method of estimating the heating load and heating costs differs from conventional American practice. The winter heating season in Sydney covers a period of 22 weeks from May to September. On certain days during this period, heating will be necessary only for about four hours in the morning and perhaps five hours at night. At other times, heating may be required throughout the day and for several hours at night. Because of these intermittent periods, we decided that the degree-day method would not be as suitable for the computation of our heating load for all classes of building as it is for climates in which the outdoor temperature is always lower than the indoor temperatures. Consequently, a modification of the degree-day method was developed.

Eventually the "heat load analysis" system was adopted. This system was developed by B. H. Andrew of the Australian Gas Light Company, and formerly of the Wellington Gas Company, New Zealand. Charts were prepared, showing the maximum, minimum, and average daily temperatures for the entire year. The lowest winter temperature of 40° was established as the design basis, and 65°-72° fixed as the comfort band. The charts indicated that heating would be necessary for a season of 22 weeks.

Another chart was prepared indicating the maximum, minimum, and average hourly temperatures for the year. On an analysis sheet (see Table 1), 10 different classes of buildings functioning over 13 different periods were tabulated together with the number of days and hours heating would be required. These figures indicated the peak heating requirements. Referring to the hourly chart we ascertained the average temperature difference for the entire period of 22 weeks, and established these figures as a percentage of the peak heat requirements (see the last two columns in Table 1).

For example, an ordinary residence which uses heat seven days per week has a total heating season of 154 days. If the residence is maintained at 70° at all times, the total number of heating hours is 3,696. If the

†Engineer, Air Conditioning Section, Australian Gas Light Co., Sydney, N.S.W., Australia.

TABLE 1.

Type of Building	Heating Days Per Week	Total Heating Days	Daily Heating Hours: Time	Daily Heating Hours: No. of Hrs.	Total Heating Hours	Average Hourly Temperature Difference, Deg.: 40°/60°	Average Hourly Temperature Difference, Deg.: 40°/65°	Minimum Temperature Recorded, Deg.	Average Consumption as Percentage of Peak Demand, %: 40°-60°	Average Consumption as Percentage of Peak Demand, %: 40°-65°
Residence	7	154	6 a.m.—10 p.m.	16	2,464	2.4	7.4	37	12	30
			6 a.m.—12 p.m.	18	2,772	2.8	7.8	37	14	32
			Continuous	24	3,696	4.1	9.1	37	21	37
Offices, Shops	5½	121	8 a.m.—5 p.m.	9	1,089	0.6	5.6	40	3	23
			8 a.m.—10 p.m.	14	1,694	1.6	6.6	40	8	27
Factories	7	154	Continuous	24	3,696	4.1	9.1	37	21	37
Theaters	6	132	9 a.m.—11 p.m.	14	1,848		6.5	43		26
			2—10 p.m.	8	1,056		6.6	45		27
			6—10 p.m.	4	528		8.7	45		35
Churches	2	44	9—12 a.m.							
			6—9 p.m.	6	264		7.2	43		29
Lodges	6	132	6—11 p.m.	5	660		9.2	43		36
	2	44	6—11 p.m.	5	220		9.2	43		36
Schools	5	95	7 a.m.—4 p.m.	9	855		6.3	37		26
			7 a.m.—4 p.m. and 6—9 p.m.	12	1,140		6.8	37		28
Hospitals	7	154	Continuous	24	3,696		9.1	37		37
Green Houses	7	154	Continuous	24	3,696	4.1	9.1	37	21	37

outdoor temperature was constant at 40°, the degree-days per season would be based on the number of days in which a temperature difference of 65°-40°, or 25°, was obtained. The peak demand would, therefore, be 154 x 25 degree-days. The data obtained from the weather charts, however, showed that the average hourly temperature difference is not 25°, but only 9.1°. The average gas consumption is therefore based on 9.1/25, or 37%, of the peak demand. The gas requirements for the season can be estimated by assuming that a period equal to only 37% of the total 3,696 hr. will require the peak heating requirement.

In the case of an office which is heated from 8 a.m. to 5 p.m. for 5½ days of the week, the total number of heating hours for the season is 1,089. The percentage of peak demand, as determined from our charts, is 23%. Therefore, the gas requirements for the season can be estimated by assuming that 23% of the 1,089 hr. demands the peak heating requirement.

Charts were prepared for the years 1933 and 1934 as a check against any climatic changes, and the analysis was found to check very accurately for both seasons. This system provides a very close approximation of operating costs for the season, and enables us to keep an accurate check on gas consumption for any particular installation. The customer's estimate is always given on the basis of "heating cost for period May 1 to September 30." Each year, the daily and hourly charts will be prepared from figures provided by the Sydney weather bureau, so that a constant check can always be kept on any climatic changes simply by laying the tracing of one chart upon another.

This system has also been adopted by the cities of Melbourne and Adelaide, and has shown very satisfactory service in its several applications. It is particularly suited to the milder climates and automatically operated equipment. This system may also prove to be applicable to climatic conditions in the southern part of the United States, where the heating demand is intermittent in character. Although it is somewhat of a modification of the degree-day method, it seems to be more flexible in a mild climate.

Economic Benefits of Air Conditioning

THE Philadelphia Electric Company has undertaken a series of studies to try to evaluate the somewhat intangible economic benefits from air conditioning. The first of these studies was conducted in the Philadelphia plant of the American Tobacco Company where complete all year air conditioning has been installed. Cigar manufacturers in Philadelphia generally recognize that humidifying equipment is essential for the production of high quality cigars. However, some doubt existed as to whether the additional expense for complete air conditioning was warranted. This involved the addition of compressors and auxiliaries to maintain a uniform wet bulb during the summer months.

Under normal summer conditions an average of 50 girls per day for 75 days would become sick or indifferent to their work and would work one-half day, leaving at noon. Further, due to the discomfort, many girls would leave the plant and obtain work at summer resorts.

After complete air conditioning was installed, it was found that over a 75-day period the lost time was reduced from an average of 50 girls out one-half day, to an average of 5 girls out one-half day. Labor turnover was reduced by 100 during the summer months, materially decreasing training expense. In addition, more comfortable working conditions increased the efficiency of workers to such an extent that rejects were reduced from between 3 and 4% to between 0.5 and 1%.

Under normal summer conditions, due to temperature and humidity in the plant, production would fall from 4,000 to 3,600 cigars per machine per day, a decrease of 10% in production. With complete air conditioning, the machines were worked at full capacity and produced 4,000 cigars per machine per day. Summarizing, the gross savings made from reduction in lost time, reduction in labor turnover, reduction in rejects, and increase in production, amounted to $29,546 per year. Since the total owning and operating cost of the added air conditioning was $6,174 per year, there was an annual outright profit of $23,371. The benefits derived from this installation far exceeded expectations and are recognized by the American Tobacco Company.

In an effort to evaluate the effect of air conditioning on health the Philadelphia Electric Company conducted a three-year study comparing the health records of employes in their air conditioned offices with the records for employes in similar offices which were not air conditioned. The records for employes in the first floor area at 10th and Chestnut Streets were analyzed and compared for one year prior to the installation and two years after the installation. This analysis showed an average reduction of 39.5% in lost time due to minor illnesses during the two years following the installation.

Studies in the new Kensington Office were carried out along different lines. Here the air conditioning was installed at the time the building was erected and offered no opportunity to make before and after studies of employes. It was, therefore, decided to compare health records of men and women employed in this office with a similar office that was not air conditioned. The Frankford Office met these requirements and was selected for the comparison. This comparison covered a one-year period. Absences due to minor illnesses were found to be 56% less in the air conditioned office.

The air conditioned offices showed an average decrease in lost time of 45.4%. An analysis of these data indicated that 75% of the lost time was due to minor illnesses.—*H. H. Mather in "Refrigerating Engineering."*

The Flow of Air in Ducts

By EMORY KEMLER†

THE satisfactory operation of an air heating system and of an air conditioning or cooling system requires that the duct system be so designed that the proper amounts of air will be transmitted to the desired places with the minimum expense. While there are other factors to be considered in the design of duct systems, this article deals with the design of the system to maintain the proper balance between pressure drops to give the desired flows. If an excess of pressure be available for distributing the air, dampers can be used to balance the system, but in every case their use represents a loss of energy. A properly designed and balanced system not only keeps the use of dampers to a minimum but also keeps the pressure which must be supplied to the system to a minimum and thereby reduces power costs.

The determination of pressure drops in the case of turbulent flow has been on a rather unsatisfactory basis. Those designers who have collected data from practice and experiment are able to make calculations over the range of data obtained from their experience with satisfactory accuracy, but when it is necessary to make calculations on conditions which may apparently vary only a little from conditions which have been investigated, it is not safe to extend the data. Those who have not had the benefit of experience must resort to the use of empirical formulas and often find them unsatisfactory.

The introduction of Reynolds number as a criterion for determining the friction coefficient or factor has done much to alleviate this difficulty. It offers an easy method of investigating the effect of various factors on the flow as well as a rational method of making calculations for unusual problems. A very complete analysis of the data on the flow of fluids (gases and liquids) in pipes has been made by the writer and was published in the Hydraulic Transactions of the ASME for August, 1933. A paper by R. J. S. Pigott on the flow in pipes in the August, 1933, *Mechanical Engineering* gives data based on his experience and the author's curves which can be used for the design of any type of conduit. The data given in these two papers form a background on which designers can base their calculations and on which research workers in the field of fluid flow can plan their work to be most effective.

†Assistant Professor of Mechanical Engineering, University of Pittsburgh.

It is not intended to convey the idea that empirical formulas cannot be applied to flow problems or that they will not give reliable results. If they are based on accurately taken data, they will hold for the test conditions covered and for these conditions can be made as accurate as any other formula. Ordinarily, however, it is not practical and is too expensive to cover the entire range of conditions which might be encountered in practice so that some generalized method of analysis such as will be given in this article is desirable for determining the safe range for empirical formulas and for use where special problems are encountered.

The general formula commonly used for determining the pressure drops in any conduit or piping system is

$$dP = \frac{flv^2r}{2gD} \text{ or } dh = \frac{flv^2}{2gD}$$

Where dP = pressure drop in lb. per sq. ft.
l = length of pipe in ft.
g = 32.2 ft. per sec. per sec.
D = pipe diameter in ft.
v = mean velocity in ft. per sec.
r = fluid density in lb. per cu. ft.
f = friction factor.
dh = loss of head in ft. of fluid.

These formulas hold for the case of a liquid or for a compressible fluid where the pressure drop is less than about 10% of the initial pressure.

The only difference beween the method of analysis using Reynolds number and the empirical formulas is in the manner in which f is obtained, or in the value of f to be used.

It has been shown that the friction factor, f, will depend on D, the diameter of the pipe, v, the velocity, r,

TABLE 1.—RELATION BETWEEN PIPE OR DUCT MATERIAL, DIAMETER, AND NUMBERED CURVES ON FIG. 2

Curve No. Refers to Curves Numbered 1-12 on Fig. 2	1	2	3	4	5	6	7	8	9	10	11	12
Kind of Pipe or Duct	Figures below are diameters of pipe or duct in inches. In the case of tubing they are the actual inside diameters; in pipe, they are the nominal diameters of standard weight pipe.											
Galvanized iron ducts (clean)	—	—	30	10-24	6-8	3-5	2½	1½-2	1¼	1	¾	½
Drawn tubing, of brass, lead, tin, glass	0.35 up	—	—	—	—	—	—	—	—	—	—	—
Steel and wrought iron pipe (clean)	72	48-66	14-42	6-12	4-5	2-3	1½	1-1¼	¾	½	⅜	¼
Ducts of best cast iron, cement, light riveted sheet	—	—	48-60	20-48	12-16	5-10	3-4	2-2½	1½	1¼	1	—
Pipe of aver. cast iron, or rough formed concrete	—	—	96	42-96	24-36	10-20	6-8	4-5	3	—	—	—
Pipe of first class brick or of heavy riveted or spiral riveted sheet	—	—	220	84-204	48-72	20-42	16-18	10-14	8	5	4	3

the density of the fluid, and m, the viscosity of the fluid. Reynolds showed by dimensional analysis that if f was to depend on these factors it would vary with them according to the value of the quantity Dvr/m, that is, for a particular value of the quantity Dvr/m, f will have only one value regardless of the individual values of D, v, r, and m. This statement applies strictly only to smooth pipes. For rough pipes, it has been found (see references given before) that f varies some with the pipe size. For a given pipe size, it has been found that f is independent of the individual values of v, r, and m so long as the quantity Dvr/m remains the same.

For liquids, r can be considered constant for all practical purposes, and the Reynolds number is written as $R = Dv/k$, where k is the kinematic viscosity or, $k = m/r$. For most ventilation problems, the pressure differs but slightly from 14.7 lb. per sq. in., and if we consider the mean pressure as being that, r will vary only with the temperature. Since m likewise varies only with the temperature, they can be combined and k will then be a function of temperature for air at atmospheric pressure. Fig. 1 gives the values of k at atmospheric pressure and different temperatures. For any other pressure, multiply the value of k found from the chart by that pressure and divide by 14.7. From this figure, it can be seen that k does not vary much for the range of temperatures encountered in heating or air conditioning work as compared with variations in velocities and pipe sizes.

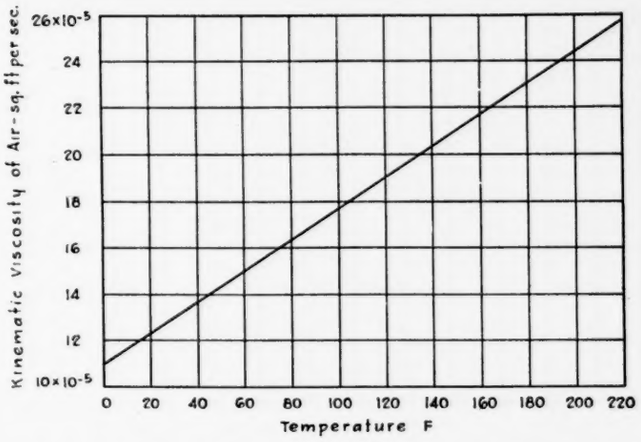


Fig. 1. Values of kinematic viscosity (k) of air at 14.7 lb. per sq. in. and at various temperatures. (For any other pressure, multiply by that pressure and divide by 14.7.)

Fig. 2 shows how f varies with Reynolds number. Table 1 shows which curve to use for various sizes and kinds of pipe or conduit. These curves can be found in either of the above references mentioned. Our knowledge of how f varies with Reynolds number is relatively complete. The only question on which more information is needed is how the relative roughness varies with different kinds of duct construction and materials. The

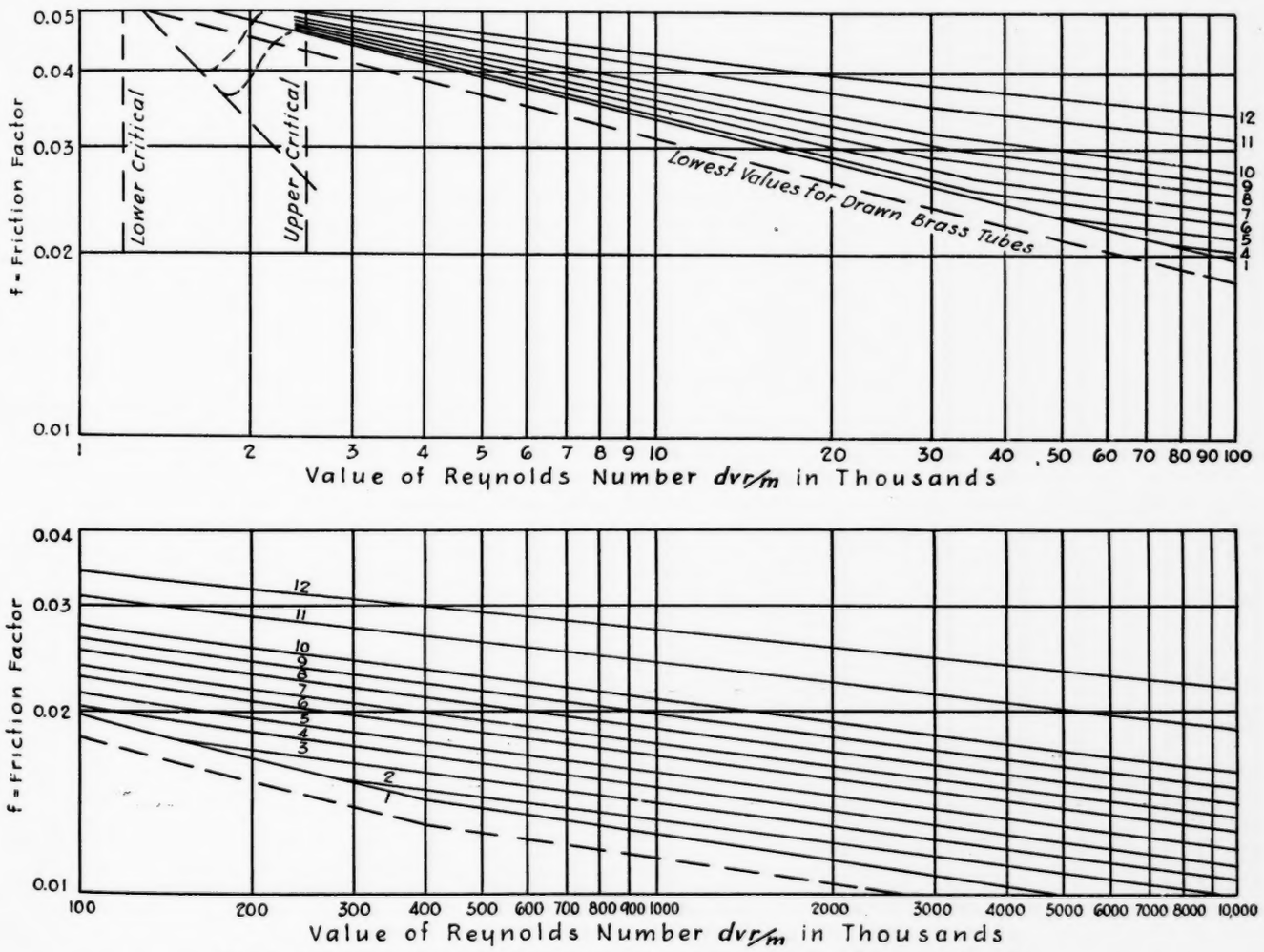


Fig. 2. Relation between friction factor (f) and Reynolds number (see Table 1).

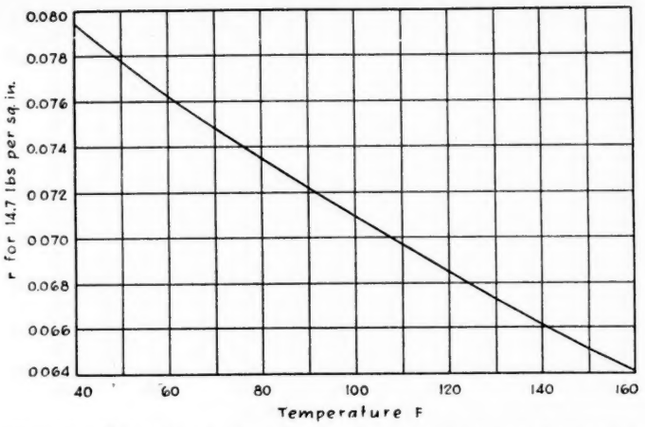


Fig. 3. Density of air at 14.7 lb. per sq. in. and various temperatures. (For other pressures multiply by the pressure and divide by 14.7.)

values for the curve numbers given are for average duct construction and will in general be safe enough to use. Specific comments on the limitations will be given later.

Application to Finding of Pressure Drops in Ducts

To further demonstrate the use of Reynolds number and to see how f will vary with different flow conditions, several examples will be worked out.

We will consider first a 3-in. diameter galvanized iron duct in which the velocity is 300 f.p.m., the temperature is 135°, and the pressure 14.7 lb. per sq. in. The diameter expressed in feet is 0.25, the velocity is 5 ft. per sec., and the kinematic viscosity 20×10^{-5} ft. squared per sec. from Fig. 1. The Reynolds number is

$$R = \frac{Dv}{k} = \frac{0.25 \times 5}{20 \times 10^{-5}} = 6{,}250.$$

The f curve to use in Fig. 2 can be found from Table 1 as curve 7. The value of f is found from Fig. 2 as being 0.037 by entering the chart at 6.25 (thousands) and moving vertically to the intersection with curve 7.

Consider a second example of a 12-in. diameter duct in which the velocity is 1,200 f.p.m., the temperature 135°, and the pressure 14.7 lb. per sq. in. In this case, we have the Reynolds number,

$$R = \frac{1 \times 20}{20 \times 10^{-5}} = 100{,}000.$$

Table 1 gives the roughness curve as number 5 and the value of f is found to be 0.021.

These examples show that over the range of operating conditions found in ventilation work there is a wide variation in f. In the smaller distributing ducts where the velocities are low to keep down noise, the Reynolds number is low and f is correspondingly higher. In large ducts where the velocity is high the Reynolds number is high and f is found to be lower. The value found for the larger duct is somewhat lower than the value normally used, but in the branch ducts, the value normally used may not be high enough. The value of about 0.024 or 0.025 which is frequently used for the entire system may not lead to results very much in error since this value is higher than the value which should be used for large ducts and is lower than that which should be used for small ducts (assuming well made sheet metal ducts). Since the pressure drop varies as the velocity squared, the actual pressure drop may be enough larger for the large pipe system to compensate for the deficiency which will exist in the small ducts. The Reynolds number method of analysis further shows us that a duct of any reasonable size approaches very closely to the smooth pipe line. This line is the lowest value which can be obtained with any type of conduit. The curves also show what might be expected of ducts lined with sound absorbing materials. Such materials will in general have the effect of increasing the roughness of the duct and increase f. For small ducts, the increase in f will not be so great as with large ducts, primarily because of the lower Reynolds number in the small ducts. However, since relative roughness is the controlling factor, the large size will show less effect of the roughness and therefore a relatively smaller increase in coefficient than the small duct.

Equivalent Diameter of Rectangular Ducts

An investigation of the data on the flow of fluids in non-circular conduits was made by K. M. Peters, and the results of his studies are given in his comments on the writer's paper in the Hydraulic Transactions of the ASME. He found that in turbulent flow, which covers practically all ventilation problems, the shape of the section had no effect on the f when the equivalent diameter was used for pipes of equal roughness. This fact permits us to use the curves just given for rectangular pipes having the same equivalent diameter as a circular pipe.

The term equivalent diameter may have two different meanings. There is one equivalent diameter which is used to give the equivalent pipe size to be used in Reynolds number and which will be discussed here.

The mean hydraulic radius is a term which has been used in making calculations for non-circular sections. It has been developed on the supposition that the resistance of pipes of the same area is proportional to the fluid in contact with the sides of the pipe.

$$M = \text{Mean hydraulic radius} = \frac{\text{area of section}}{\text{perimeter of section}}$$

For a circular pipe $M = d/4$. The equivalent diameter for rectangular ducts can, therefore, be given as

$$D_e = 4M = \frac{4 \times \text{area of section}}{\text{perimeter of section}}$$

where D_e is the diameter of circular pipe which will give the same friction factor as the rectangular shaped ducts. The formula for pressure drop then reduces to:

$$dp = \frac{flv^2r}{2g \times D_e} = \frac{flv^2r}{2g \times 4M}$$

For the same velocity of flow, the pressure drop is the same when the equivalent diameters are equal.

Example of Use

To determine the pressure drop in a 4 in. × 6 in. rectangular duct where the velocity is 600 f.p.m., the temperature 135°, and inlet pressure is 14.7 lb. per sq. in.

The formula for pressure drop can be reduced to the form:

$$dp = 0.00895 \frac{flv^2r}{m} = 0.0358 \frac{flv^2r}{d_e}$$

Where dp = pressure drop in in. of water.
l = length of duct in ft.
m = mean hydraulic radius in in.
r = density in lb. per cu. ft.
v = velocity in ft. per sec.
d_e = diameter in in. of a circular pipe or the equivalent diameter of a rectangular section to be used in finding dp.

The equivalent diameter is given by

$$d_e = 4 \times \frac{4 \times 6}{2(4+6)} = 4.8 \text{ in.}$$

The Reynolds number can be written as

$$R = 0.0833 \frac{d_e v}{k} = \frac{0.0833 \times 4.8 \times 10}{20 \times 10^{-5}}$$

$= 20{,}000$. Fig. 2 shows that $f = 0.030$

$$dp = \frac{0.0358 \times 0.030 \times 1 \times (10)^2 \times 0.0668}{4.8}$$

$= 0.0015$ in. of H_2O per ft. length

Fig. 3 gives the density of air at 14.7 lb. per sq. in. and different temperatures. For other pressures multiply by the pressure and divide by 14.7.

The writer acknowledges the helpful discussions of Prof. F. H. Stiening, associate professor of mechanical engineering at the University of Pittsburgh.

Air Conditioning Improves Plate Making and Offset Printing

AN air conditioning system installed a few months ago in one of the large offset houses is reported as showing results of a very definite and satisfactory nature.

"The immediate benefit of this air conditioning installation, and the purpose for which it was installed," said the superintendent of this firm, "is the fact that the humidity in our pressrooms and in our plate-making room can now be accurately controlled, for when the humidity of the air starts to rise, it means trouble for the offset printer.

"Plate making is one of the most important operations on lithographic printing. A glue solution is used in this process, and if the humidity in the plate-making room is too high, this glue solution becomes too soft, causing the proper production of plates to be difficult.

"On the other hand, with definite control and regulation of humidity in our plate-making room, we can obtain uniformly good results because we can keep the humidity constant at, say 50%, regardless of daily variations in atmospheric conditions outdoors.

"In our offset pressrooms on the third and fourth floors of our plant, we find that air conditioning gives us another advantage. Before the air conditioning system was installed, one of our main troubles there was in the shrinkage or stretching of paper, due to changes in weather conditions.

"Formerly when a change in the humidity caused the paper to stretch or shrink, we found when we came to printing the additional colors, which might be several hours later, or even the next day, that the paper had varied in size after printing the first color, that it was impossible to get the best results.

"However, with humidity in the pressrooms under control at all times, our results are now much more satisfactory, and there is practically no spoilage due to weather conditions. With air conditioning, we make our own weather to order, and every job shows uniformly good results.

"Another way in which we find that air conditioning helps us in the pressrooms is in overcoming trouble with printers' rollers and inking materials. In warm weather, or on any damp day, these rollers had a habit of getting soft. But under the uniform conditions now obtained as to temperature and humidity, the ink rollers work more evenly, and production is speeded up materially.

"In printing by the offset process, which is what lithographic work really is, water is used in order to keep the plate from getting too dry. If the plate dries too rapidly, more water must be added by means of what are technically known as 'fountains.' On a dry day, these fountains must be well opened, so that the plates receive the required amount of water.

"Before we installed air conditioning, on a dry day we would have to keep the fountains wide open to keep the supply of water on each plate. Conditions of weather and temperature might change overnight, and if the pressman should happen to forget to set his fountain back, he might spoil a job, or get an entirely different result than he had on the day before," he points out.

"But with air conditioning, giving us a means of keeping our humidity constant, it is possible to set our fountains at a certain point, and know that results will be uniformly accurate, and relatively the same each day. Thus we can operate much more efficiently, with an assurance of satisfactory results.

"You see, humidity control is the thing in which we are chiefly interested from the standpoint of operation. However, temperature control has definite advantages too, in improving the personal comfort of our workers. In the air conditioned rooms the men do not perspire so freely, and paper can be handled more easily, without soiling. So air conditioning in our plants has resulted in an improvement both in our processes and in the general efficiency and comfort of our employes."—*Abstracted from "The American Pressman."*

11,000 Attend Oil Burner Show; 1936 Biggest Burner Year Is Prediction

FREE burner service or free parts beyond the regular guarantee of one year on new oil burner installations were ruled out by the Board of Directors of the Oil Burner Institute at the 12th annual show and convention of the Institute at Detroit, April 14-18. Attendance at the show was approximately 11,000, of whom about 8,000 were from the heating trade. Twenty-seven different air conditioning units were on display at the show. Twenty-one oil burner manufacturers exhibited, 11 of whom showed boiler-burner units.

One of the outstanding talks at the convention was that by Ralph S. Beale, sales manager of the Norge Heating and Air Conditioning Div., Borg-Warner Corp., Detroit, on "The Great Need of the Oil Burner Market is Inspirational Salesmanship." In his talk Mr. Beale predicted that 1936 would be by far the greatest year of the oil burner industry.

W. F. Brannan, Anchor Post Fence Co., newly-elected president of the OBI

The Institute's new president is W. F. Brannan, president of Anchor Post Fence Co., Baltimore. He succeeds W. J. Smith of the Cleveland Steel Products Corp. G. Harvey Porter was reelected managing director and secretary, and C. F. Curtin was again appointed assistant secretary.

The Board of Directors authorized and instructed the managing director to study and adopt a plan for regional contact through appointment of a well qualified individual from the membership of the institute in each of the major marketing areas. A plan is contemplated whereby a uniform method for improvement of industry conditions throughout every logical market will be organized.

Dealer day was held Thursday, April 16. T. L. Bernard of the Detroit office of N. W. Ayer & Son, spoke on "Market Analysis." He defined the purpose of a market analysis in three words—"to find out." In closing he summed up his remarks by saying "Know Thy Prospects."

In his talk on "Inspirational Salesmanship," Mr. Beale said that he was dissatisfied with the accomplishments of the oil burner industry in spite of the fact that 1935 was the best year so far in the business. In his opinion, the industry does not realize the tremendous sales possibilities confronting it, and said that oil burners were only at 4.6% of saturation of their market. Mr. Beale said that too many salesmen in the industry have been engineering minded, and consequently lack the inspirational enthusiasm which has made other appliance markets so successful. Believing that the engineering mind is too logical, and that too much intelligence on the part of a salesman slows him up from the standpoint of all those enthusiastic and spirited qualities which make for greater salesmanship, he said that sales should be divorced from installation and servicing with specialty salesmen in charge of selling, and technical men handling the installation and service.

Mr. Beale summarized the results of a nationwide survey which his company has conducted for the past three years on the markets for appliances. Housewives were asked whether they were going to buy this and that home-making convenience during the year, and the replies were measured both from the positive standpoint of buying intent (that is, those that were sure they were going to buy), or of a qualified buying intent

(Concluded on page 76)

At the annual banquet the convention heard W. J. Smith, the retiring president . . . W. F. Brannan, the new president . . . and Gar Wood, the principal speaker of the evening

GETTING DOWN TO FUNDAMENTALS

12—Estimating Sun Heat Through Glass Windows and Skylights

ORDINARY window glass has the property of being transparent to sun energy. In other words, a considerable part of the radiant energy of the sun which strikes a surface of ordinary window glass passes right through it as radiant energy. This energy is largely converted into sensible heat as it strikes solid surfaces inside a room and as such goes to increase the cooling load in summer. Because of this situation there are many cases where the heat received from the sun and transmitted to the interior must be estimated and allowed for in providing adequate cooling capacity. Our object is to outline a method whereby the amount of this sun heat can be estimated.

Keep in mind that of the sun energy received on a glass surface not all passes through, for some is reflected and some is absorbed by the glass. Moreover, the amount of heat which goes to add to the cooling load can be decreased by keeping windows or skylights out of the direct path of the sun's rays by shading, by painting, by the use of awnings or blinds. As a result it can be generally stated that the sun heat with which we are here concerned is always less than the amount of sun energy received on a black surface normal to the sun.

An Estimating Method

This fact suggests a method of estimating by making proper reductions in the amount of sun heat received on a black surface normal to the sun. A formula for applying such a method can be set up as follows:

$$H_g = ASI_g \qquad (5)$$

where

H_g = Sun heat transmitted by exposed window glass, B.t.u. per hr.,

S = Shading factor, expressed as decimal of heat transmitted by glass exposed to sun,

I_g = Intensity of solar heat transmitted by clean window glass exposed to sun, B.t.u. per hr. per sq. ft.,

A = Net area of glass actually exposed to direct rays of sun, sq. ft.

It is to be particularly noted that this formula with the terms as defined applies only to windows and skylights using ordinary window glass. There are various glasses in use which have heat transmitting properties considerably different from the ordinary grades of window glass. Neither does the formula in this form apply to special glass shapes such as glass brick or glass having molded surfaces designed to deflect sun heat. Ordinary window glass is in such general use, however, that the formula can be applied to a great many jobs.

To be usable, suitable values for the several factors in equation (5) must be available. We will now turn attention to presenting such values as are obtainable.

Sun Heat Through Glass

Values of I_g can be calculated by knowing, or approximating, the amount of solar radiation received on a black surface normal to the sun and then making suitable allowances. The method is essentially similar to that used in computing the intensity of sun heat received on vertical walls and horizontal roofs and outlined in the previous article in this series. The actual intensities for use in equation (5) will not be the same as those used in computing sun heat through walls and roofs, however, and it is necessary to prepare a separate table.

Table 1 gives values of I_g for four different north latitudes within which latitude range practically all of our important cities lie. Typical cities lying within these latitudes are also listed as an aid in using the table. The values in the table are for a clear day in late summer and therefore can be taken as being those useful in estimating peaks for summer cooling. While the values in the table cannot be shown to be strictly accurate, they are believed to be accurate enough for most practical applications. They illustrate the hourly variations to be expected and make it clear that windows in vertical walls transmit considerably less sun heat than do flat skylights. Sloped skylights lie intermediate between horizontal skylights and vertical windows.

Care should be used in fixing values for skylights set at an angle to the horizontal. Where it faces the north it is probable that a sloped skylight can be neglected altogether. Another means of decreasing the heat transmitted by a skylight is to surround it by a vertical shield or to set it in a well three or four feet deep. Horizontal skylights unshaded transmit large amounts of sun heat, as the table clearly shows.

Shading Factors

Suitable allowances for shading are of the utmost importance but not only is the numerical information on the subject still in a confused state, but in many cases it is difficult to determine in advance just how much shading of windows and skylights will be present in the actual surroundings of a particular installation.

Shading by trees is generally agreed to be effective if complete. While calculations can be resorted to this is seldom practical without having more detailed measurements of relative location of trees and windows than are usually available. Judgment, therefore, is necessary in most actual estimates to decide where to fix a value of S for tree shading.

Surrounding buildings often cut off the sun's rays during certain hours, and when this occurs practically no sun heat is transmitted through windows so shaded.

TABLE 1.—INTENSITY (I_g) OF SOLAR RADIATION IN SUMMER TRANSMITTED BY CLEAN GLASS WINDOWS AND SKYLIGHTS

(Figures are in B.t.u. per hour)

	Time of Day	PLAIN GLASS WINDOWS (VERTICAL) Facing compass point below								GLASS SKYLIGHTS (Horizontal Surface)
		E	SE	S	SW	W	NW	N	NE	
30	6AM	104	43					23	96	8
	7	167	86					14	149	56
30° North Latitude	8	185	110						135	123
	9	160	110						95	182
	10	107	90	9					42	234
	11	39	52	17						260
	Noon		10	21	10					272
	1			16	51	39				256
	2			8	87	104	40			226
	3				106	154	91			175
	4				107	178	130			119
	5				86	167	150	14		56
	6				43	104	96	23		8

Austin, Tex. — Montgomery, Ala.
Baton Rouge, La. — New Orleans, La.
El Paso, Tex. — Pensacola, Fla.
Galveston, Tex. — San Antonio, Tex.
Houston, Tex. — Savannah, Ga.
Jacksonville, Fla. — St. Augustine, Fla.
Laredo, Tex. — Tampa, Fla.
Mobile, Ala.

Cities listed above lie between 27° 30′ and 32° 30′ North Latitude

35	6AM	104	39					20	95	10
	7	167	84					9	134	59
35° North Latitude	8	185	117						125	125
	9	160	124	8					81	181
	10	107	114	20						230
	11	39	83	38						255
	Noon		38	44	23					267
	1			38	68	39				251
	2			22	103	104	26			221
	3			7	120	155	78			174
	4				116	178	120			118
	5				91	167	134	9		59
	6				45	104	95	20		10

Atlanta, Ga. — Los Angeles, Calif.
Birmingham, Ala. — Memphis, Tenn.
Charleston, S. C. — Nashville, Tenn.
Chattanooga, Tenn. — Norfolk, Va.
Dallas, Tex. — Oklahoma City, Okla.
Fort Worth, Tex. — Phoenix, Ariz.
Knoxville, Tenn. — Raleigh, N. C.
Little Rock, Ark. — San Diego, Calif.
Long Beach, Calif. — Tulsa, Okla.

Cities listed above lie between 32° 30′ and 37° 30′ North Latitude

40	6AM	104	34					18	93	14
	7	167	82					5	130	62
40° North Latitude	8	185	123						115	125
	9	160	138	17					68	178
	10	107	137	44					15	224
	11	39	114	62						248
	Noon		74	71	39					260
	1			61	86	39				244
	2			42	119	104	14			216
	3			16	131	155	65			172
	4				125	178	110			118
	5				97	167	130	5		62
	6				47	104	93	18		14

Akron, Ohio. — Newark, N. J.
Baltimore, Md. — New York, N. Y.
Berkeley, Calif. — Oakland, Calif.
Boston, Mass. — Omaha, Neb.
Camden, N. J. — Paterson, N. J.
Carson City, Nev. — Peoria, Ill.
Charleston, W. Va. — Philadelphia, Pa.
Cheyenne, Wyo. — Pittsburgh, Pa.
Chicago, Ill. — Providence, R. I.
Cincinnati, Ohio. — Reading, Pa.
Cleveland, Ohio. — Richmond, Va.
Columbus, Ohio. — Sacramento, Calif.
Dayton, Ohio. — Salt Lake City, Utah.
Denver, Colo. — San Francisco, Calif.
Des Moines, Iowa. — Scranton, Pa.
Detroit, Mich. — South Bend, Ind.
Evansville, Ind. — Springfield, Ill.
Fort Wayne, Ind. — Springfield, Mass.
Harrisburg, Pa. — St. Louis, Mo.
Hartford, Conn. — Toledo, Ohio.
Indianapolis, Ind. — Topeka, Kan.
Kansas City, Mo. — Washington, D. C.
Louisville, Ky. — Wichita, Kan.
Youngstown, Ohio.

Cities listed above lie between 37° 30′ and 42° 30′ North Latitude

45	6AM	104	29					16	92	16
	7	167	80						124	63
45° North Latitude	8	185	128	5					106	123
	9	160	150	32					54	173
	10	107	160	66					6	218
	11	39	139	89	9					239
	Noon		108	98	57					250
	1		9	87	105	39				235
	2			64	135	104	6			210
	3			31	145	155	52			166
	4			5	135	178	100			117
	5				102	167	124			63
	6				48	104	92	16		16

Albany, N. Y. — Montreal, Canada.
Astoria, Oreg. — Ottawa, Canada.
Augusta, Me. — Portland, Me.
Bismarck, N. Dak. — Portland, Oreg.
Buffalo, N. Y. — Rochester, N. Y.
Duluth, Minn. — Seattle, Wash.
Flint, Mich. — Spokane, Wash.
Grand Rapids, Mich. — St. Paul, Minn.
Helena, Mont. — Syracuse, N. Y.
Madison, Wis. — Tacoma, Wash.
Milwaukee, Wis. — Toronto, Canada.
Minneapolis, Minn. — Utica, N. Y.

Cities listed above lie between 42° 30′ and 47° 30′ North Latitude

The extent of building shading is a matter which must be studied individually for each case which arises. In the case of buildings or rooms in business districts the effects of shadows cast by surrounding buildings should be examined where at all possible. Again, however, judgment must often be resorted to because of the absence of specific data.

Awnings and shades are effective in reducing the amount of sun heat transmitted through glass. Their effectiveness varies with the way they are erected, with the materials used, color of surface and various other factors, many of which are not yet well understood.

Table 2 collects together from various sources what information is available for placing values on the shading factor S of equation (5).

TABLE 2.—SHADING FACTOR (S) FOR GLASS WINDOWS AND SKYLIGHTS

(In Decimals of Heat Transmitted Without Shade)

Total shading, regardless of source	00
Tree shade, heavy	0.20 to 0.25
Tree shade, light	0.50 to 0.60
Awning, first floor	0.25 to 0.30
Awning, upper floors	0.15 to 0.20
Inside window shade, light colored, fully drawn	0.45 to 0.55
Inside Venetian blind, light colored	0.45 to 0.55
Inside draperies, light colored	0.80 to 0.90

In making estimates using equation (5) it should be carefully kept in mind that the area, A, is the net area of glass actually exposed to the sun's rays. This is not the same as the area of the window opening often used in estimating the quantity of transmitted heat by the methods already considered in preceding articles. Allowance should be made for that part of the opening taken up by the sash or frame. Any other local factors, such as shading by lintels, should also be considered. In general it is only on the east or west exposures and during the early morning or late afternoon hours that the sun actually does strike the whole glass surface of vertical windows. In the case of horizontal skylights the full area is exposed only during the mid-day hours. It is not possible to outline simply any rules for determining just how to allow for suitable reductions of glass area or of area of window opening for particular buildings at specific hours. Walker and Hendrickson have discussed this subject to some extent and developed formulas which are based on the geometry involved[1].

Making the Estimate

Equation (5) is in such a form that with the data just presented for determining values to be used in it, it can be applied to determine the sun heat through windows and skylights at any hour of the day or for any compass exposure. In applying it, however, there are still several points to be considered. One is the hour of day to be used and another is the question of what exposures should be used.

[1]See Heating & Ventilating, June, 1933, page 22.

There are several reasons why the equation should be used thoughtfully. First, there is growing evidence that sun heat transmitted through windows is often an important factor in the total cooling load, especially in the case of private offices and dwelling rooms where normally there are but few occupants and where walls are of substantial construction. Second, sun heat through glass is transmitted practically instantly and makes its effect felt at once, as contrasted with sun heat which is transmitted through walls and roofs and where, due to time lag, there is considerable question as to how soon this heat appears on the inside and affects the cooling load. Then, since sun heat transmitted through glass is so important a factor, it should be allowed for only on those exposures where it does go to affect the particular estimate being made.

In connection with this latter point, if an estimate is being prepared for a single room having exposed walls on the north and east only it will be seen at once from Table 1 that the north wall can be neglected and that the peak hour on the east wall occurs at 8 or 9 a.m. If, however, this same room had a flat skylight of considerable area, then the maximum amount of heat at any hour during the day might come through this skylight at around noon. Both calculations should be made but only the one showing the greater amount of heat per hour transmitted should be added to the other sources of heat to arrive at peak cooling capacity.

Suppose, though, that instead of a single room a whole floor having exposures in all directions is being considered. In this case all the important combinations should be given attention. Thus, at 40 north latitude from Table 1 it will be noted that during the morning important amounts of heat may be transmitted through vertical windows facing E., NE., and SE. Partial sums across the table, considering only E., NE., SE., produce the following: 8 a.m., 423 B.t.u.; 9 a.m., 434 B.t.u.; 10 a.m., 259 B.t.u. Thus, for the morning hours the formula could be used at either 8 a.m. or 9 a.m. to get the correct combination. Similarly, in the afternoon hours the important exposures are those facing W., SW., and NW., and as before the partial sums are: 3 p.m., 416 B.t.u.; 4 p.m., 413 B.t.u.; and 5 p.m., 394 B.t.u. If, then, equation (5) is used in connection with the exposed windows at both 9 a.m. and 3 p.m. making suitable substitutions for the areas involved and for the shading conditions present at each hour, the larger of the two heat quantities obtained can be added to the other items of heat gain to determine the cooling load. This case may also involve skylights, and if so, a similar calculation for them should be included at the two hours just mentioned. A third calculation for the skylight at noon could be made as a check. In this case the largest heat quantity of the three computed could be taken.

A third case arises where zoning is being considered. In such cases (and in the others too if sufficient is at stake) the equation can be applied to every hour of the day and to every exposure.

Thus, while there is still no one generally accepted method of applying equation (5) its application can be made in as much or as little detail as the case under consideration seems to deserve.

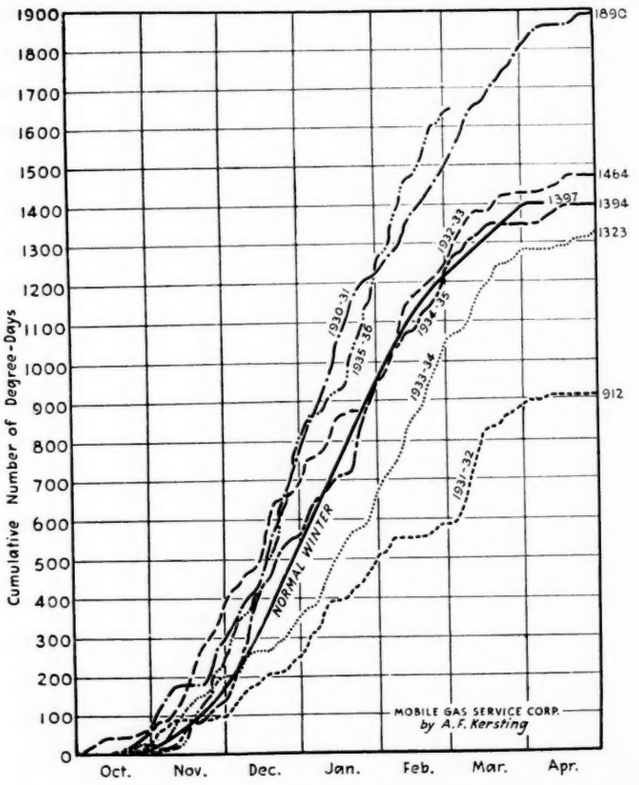
Degree-Day Chart Shows Why Bills Vary

THE degree-day unit is used in various ways by the Mobile Gas Service Corp., Mobile, Ala., to show its customers how their gas bills vary with the weather, according to A. F. Kersting, divisional industrial engineer of that utility.

One of the methods used is to plot vertical bars, extending downward, as shown in Fig. 1, by days, the bars being proportional to the number of degree-days. This is kept up to date throughout each season, and the heavy curve plotted through the bars indicates what the normal weather should be. These are also plotted on the same sheet for the preceding season, so that the customer can see the comparison between present weather conditions and last year's, and the effect on his bills.

A second chart kept shows the cumulative number of degree-days for various seasons and for a normal season, as shown in Fig. 2. The customer can easily be shown whether the number of degree-days is running above or below normal or above or below the preceding year. It is pointed out on the blueprint on which this information is charted that other variables such as dampness or windy weather may also have an effect on the fuel required.

It is interesting to note that this utility has found out that fuel consumption in Mobile is more nearly in proportion to degree-days based on a 68° basis than on 65°. However, 65° is used as the base inasmuch as it is so commonly accepted.



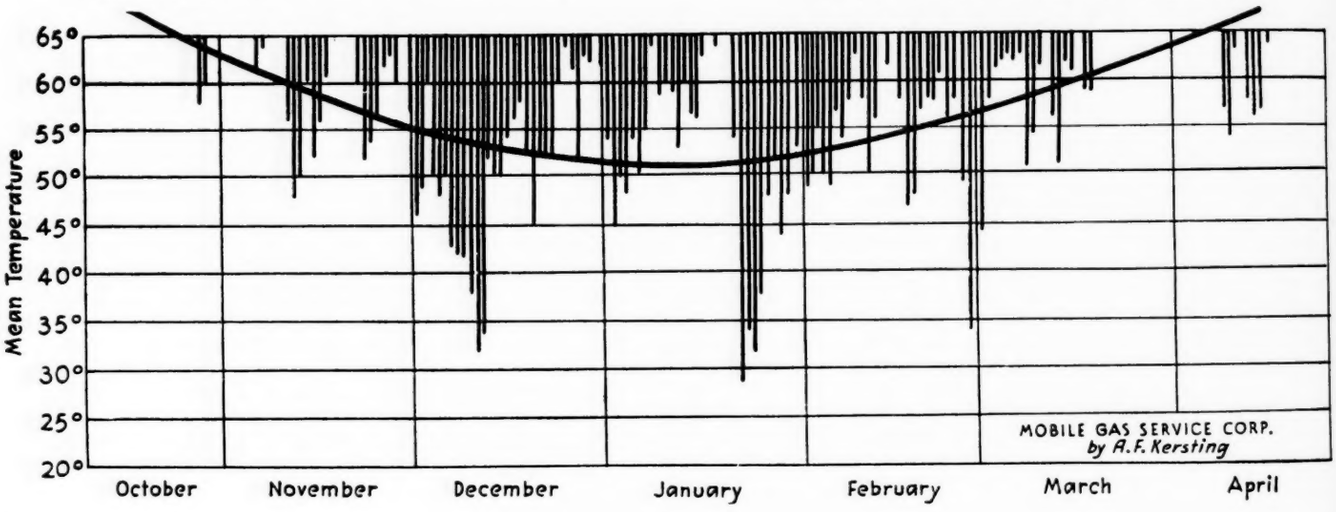


Fig. 1 (left) and Fig. 2 (below). Two ways of showing the comparison of current degree-day figures with normals. Fig. 1 shows cumulative totals, while Fig. 2 shows daily totals for both normal and current periods.

Research Rates Effect of Atmospheric Conditions

SUNSHINE influences more people than any other outside atmospheric condition, according to research conducted at the John B. Pierce Laboratory of Hygiene at New Haven, and described in a paper presented at the annual meeting of the ASHVE by Dr. C.-E. A. Winslow and L. P. Herrington, directors of that institution. The experiments were conducted on a group of some 80 persons. Next, the second outside atmospheric condition to affect human beings is relative humidity, followed by the total number of ions in the air.

According to the investigators, the number of total ions in the air in a city street in New Haven is higher than in the adjacent countryside. It rises in winter and falls in summer. It rises with southerly (sea) winds. Total ion counts are highest on cool, moist and relatively windless days.

Automatic Controls for Year 'Round Central Fan Systems

APPLICATION of automatic control to central fan systems has been treated in recent issues. Preceding articles have classified and defined the controls and their controlled equipment, have illustrated by diagrams some of the many ways that control is secured in central fan plants for use in winter and for use in summer. The present purpose is to show diagrammatically a few of the control arrangements now in use when a single central fan plant is intended for year 'round operation. This is assumed to mean that the plant must be capable of cooling and dehumidifying the air at certain periods and able to add heat and moisture to it at other times.

As in the preceding articles, the intent is to present the diagrams as simply as possible, sacrificing completeness where necessary in order to secure simplicity. Also the aim is to move generally from the simple and more easily understood toward the complex and less readily understood. In the limited space available it is not possible to attempt to present separate diagrams showing each of the many combinations of control equipment now in use or even to cover all the principles involved. However, enough diagrams are included to illustrate the use of controls with both air washers and surface heat exchangers. Also to illustrate some of the methods of securing automatic switching from summer to winter operation, control from dewpoint temperature, from room conditions, from outside conditions, and from combinations of outside and inside conditions.

About the Diagrams

In form and outline the diagrams are the same as those in preceding articles. Symbols used for equipment are also the same. So far as possible relative locations of the several parts have also been retained. These several features are intended to assist in securing a ready grasp of the meaning. As heretofore, the diagrams are not to scale in any direction, nor do they illustrate actual equipment. Paths for entry of outside air and exhaust of used air are shown in all diagrams regardless of what construction features might be necessary on the site.

In all the diagrams where it is intended that a device be exposed to maintained room air conditions of either temperature or humidity or both, the assumption is made that diagrammatically the device can be equally well shown located in the exhaust duct, the return duct, the bypass duct or in the room itself. This assumption seems justified for simplifying the diagrams even though it may not strictly agree with the actual facts in all installations.

So also where a device is exposed to outside air the diagrams make no distinction between showing it located anywhere outside the building enclosure or directly in the path of the entering air stream. Diagrammatically, location of the device in the outside air is to show that it is exposed to outside air conditions, and construction details or safeguards are neglected.

For the sake of simplicity, too, devices located in the outside air are confined to temperature controllers on the diagrams. Evidently humidity controllers can equally well be located there also but are not shown. Moreover, certain arrangements such as connections between the fan motor and the outside air dampers are omitted, for this arrangement, illustrated in one of the diagrams in a previous article, can be added at will.

Operating Requirements and Control

Developments of year 'round central plants in recent years have caused increasing attention to be given to automatic control of their operation. In general, the demand has been that the operation shall more and more approach the fully automatic with less and less manual manipulation. In this connection it is important to note that a central fan system is not necessarily under automatic control simply because some automatic devices are attached to it.

In recent years, too, ideas about the temperatures and humidities to be maintained have changed. In early comfort plants practice was to maintain one set of inside conditions the year 'round with the figure set at or about 70° dry bulb. While this is satisfactory in winter it has now come to be accepted that in summer operation the temperature must be considerably higher—almost never lower than 75° dry bulb and sometimes not under 80° dry bulb. This means that the controls must be capable of maintaining two separate sets of indoor conditions at different times during the year instead of keeping one set throughout the year.

Then came the further idea that, in summer especially, the indoor conditions should change as the outdoor conditions change. Control in summer must be capable of changing these conditions automatically if this requirement is met.

It is also well recognized now that in most localities there are times during the year, especially in the fall and spring, when a year 'round plant will need to use its summer equipment during certain hours of a day and its winter equipment during other hours.

As these various practices and ideas have grown, automatic control of year 'round plants has grown correspondingly, and methods and equipment have been devised and adapted to meet the changed operating requirements.

It will be noted that the ideas just mentioned affect the summer operation particularly. To some extent the new methods of year 'round control were outlined and illustrated in the previous article dealing with summer plants. Space limitations did not permit illustrating all the methods in use though. Methods devised for automatically or manually shifting the control from the summer equipment to the winter equipment have

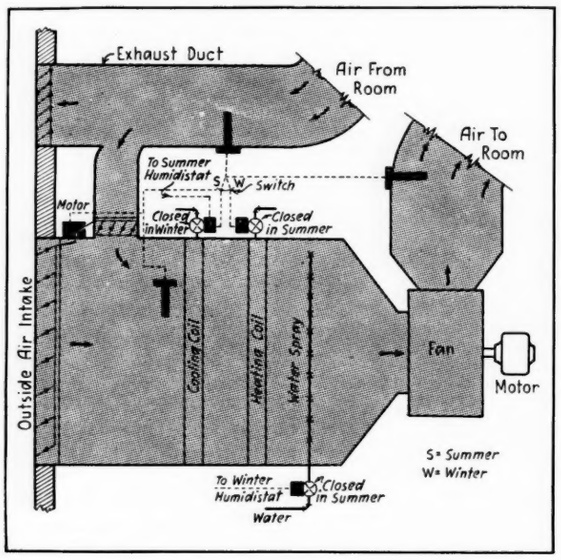


Fig. 1.

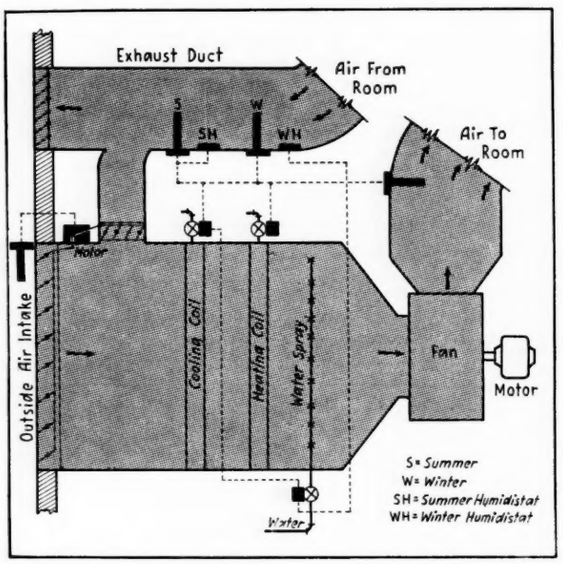


Fig. 2.

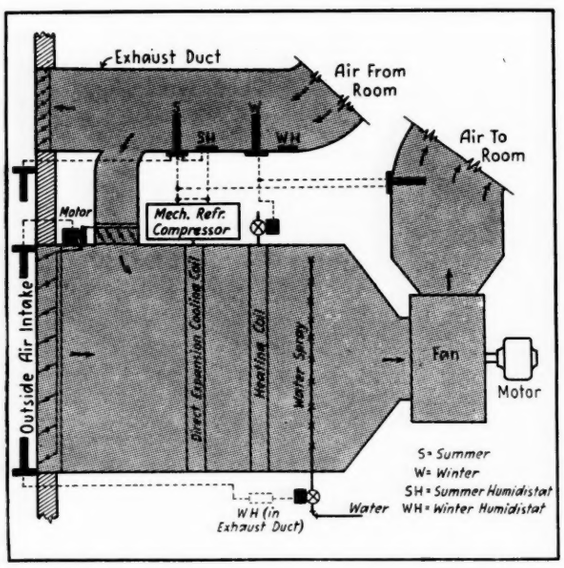


Fig. 3.

not been mentioned in previous articles where the control arrangements illustrated were for use in either summer or winter, but not for year 'round plants. We can now discuss this matter of switch-over.

Switch-over Methods

A year 'round plant can be considered as made up of a winter plant and a summer plant, or of a heating plant and a cooling plant. The switch-over consists of taking the one out of operation and putting the other into operation. It can be done manually or automatically. If done manually the operating control of the system is not automatic but is merely semi-automatic.

Manual switching may involve much or little work depending on the particular control equipment used in the plant as well as on how the control equipment is arranged. At one extreme it may be necessary manually to open and close or adjust valves or dampers, and by hand to adjust and reset a large number of sensitive elements for both temperature and humidity. At the other extreme it is possible so to select control equipment that the entire manual switching may be accomplished by the single operation of moving a lever or by pressing a button.

There are a number of ways of automatically accomplishing the change-over. They also depend on the characteristics of the control equipment selected from that available.

One method uses pilot thermostats or humidistats, or both, to make available the energy necessary to throw the switch or press the button. This same operation may reset all auxiliary equipment and thus accomplish fully automatic change-over from winter to summer operation.

Another method uses what amounts to two sets of sensitive elements—one to control summer operation and the other to control winter operation. The sensitive elements are so adjusted relative to each other that as conditions change the control shifts from one to the other. The same general idea can be carried out by the use of a single instrument or by instruments into which more than one sensitive element is built. This method has the virtue of being both simple and inexpensive.

Control equipment has now reached a point where automatic switch-over from summer to winter operation can be accomplished without any manual assistance whatever. Plants making use of such equipment are automatically operated in the full sense of the word.

It is to be noted that of the six accompanying diagrams, the first three illustrate year 'round plants using separate surface coils for heating and for cooling and with water sprays to add moisture in winter. The last three illustrate plants where surface coils are used for heating but where an air washer is installed and is available for use throughout the year. In summer, the washer extracts heat and moisture and the heating coil is shut off; in winter, it acts as the humidifying device. Return air is shown as being used in all cases.

Figs. 1 and 4 illustrate manual switch-over while the other four illustrate a few of the methods of accomplishing this automatically. For the sake of variety, Figs. 1 to 3 include arrangements for using both water surface coils and direct expansion coils. In Figs. 4 to 6

the temperature of the spray water is controlled by mixing warm and cold water under the command of a temperature controller, but details of how the steady temperature of the two supply lines is maintained are omitted. Obviously, this same idea of mixing waters at different temperatures can be applied to surface coils if desired. So is it also apparent at a glance that there are almost countless possible combinations of equipment which may be used to meet particular requirements but which are not here illustrated.

Fig. 1 includes manual switch-over with surface coil heating and cooling. In winter operation the controller at the left keeps the temperature of the air entering the heating coil steady by positioning the outside and return air dampers, while the room temperature controller (shown in the exhaust duct) positions the valve on the heating coil to keep the temperature of the room steady. A room humidistat or controller admits water to the sprays when the relative humidity in the room falls below its set point and closes the valve when its set point is exceeded. In summer operation the outside air damper is closed to a set minimum position while the room temperature controller positions the valve on the cooling coil to keep the room temperature steady. The humidistat also acts on the valve on the cooling coil whenever the relative humidity in the room exceeds its set point. The controller in the duct at the right is a low limit control throughout the year.

Switch-over necessitates both changing the summer-winter switch manually and the resetting of some of the controllers.

Fig. 2 illustrates a method of securing automatic switch-over with surface heating and cooling. Provision is made for using outdoor air for either cooling or heating whenever outdoor conditions permit. Switch-over is accomplished by using two separate temperature and humidity controllers for the room conditions (shown in the exhaust duct). One set is for summer operation and the other set for winter operation. The winter temperature controller is set for a temperature a few degrees higher than the setting of the summer controller.

In winter operation the winter temperature and humidity controllers, respectively, position the valve on the heating coil and open and close the valve leading to the water sprays. The outdoor controller at the left adjusts the dampers to control the relative amounts of outdoor and return air used, increasing the amount of outdoor air as the outdoor temperature rises or falls into a predetermined zone. A humidity control in the outside air (not shown) prevents the outside air damper from opening beyond its minimum position whenever the outdoor relative humidity exceeds its set point.

In summer operation the summer temperature controller positions the valve on the cooling coil to keep the room temperature steady, while the summer humidity controller takes command of the valve if the relative humidity exceeds its set point. An interlock between the cooling coil valve and the water-spray valve prevents the sprays from operating when cold water is being fed to the cooling coil. The outdoor controllers act as during winter operation.

The temperature controller in the duct at the right is a low limit throughout the year. On falling tem-

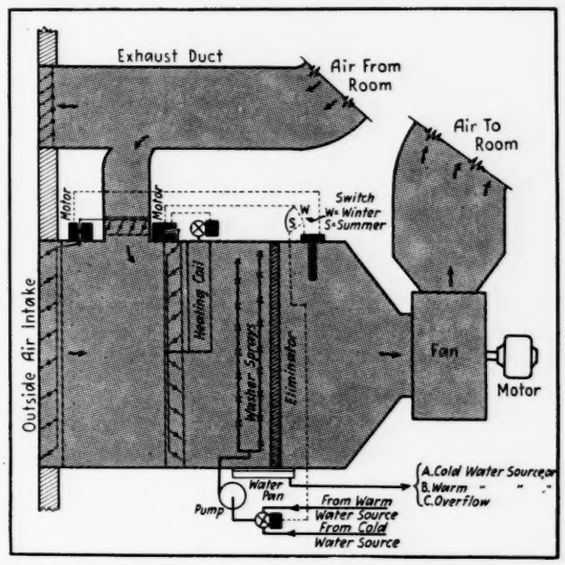


Fig. 4.

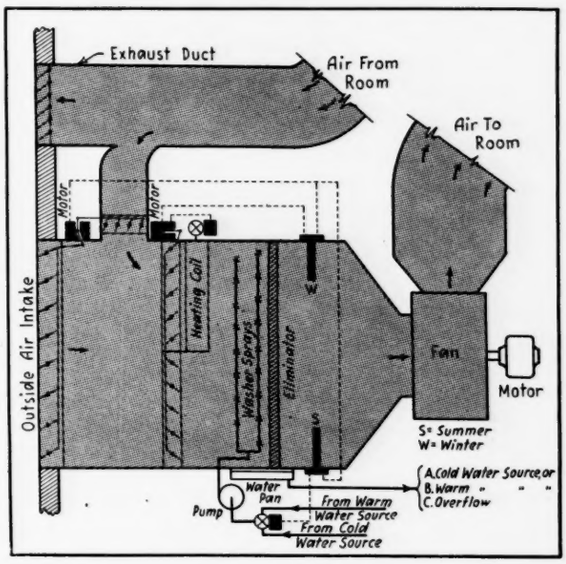


Fig. 5.

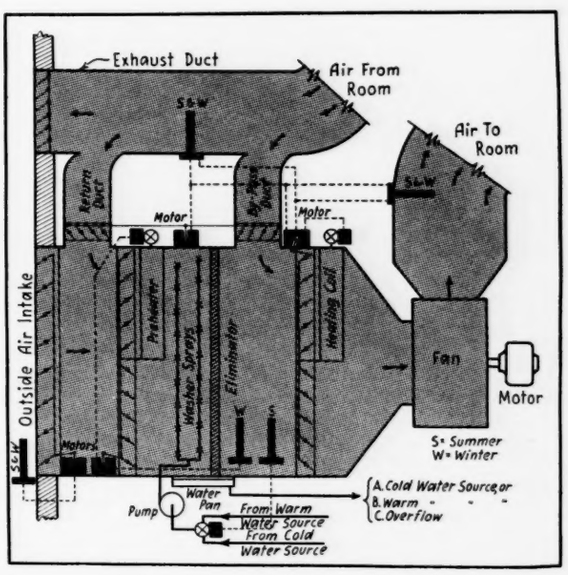


Fig. 6.

perature it first closes the valve on the cooling coil and then opens the valve on the heating coil.

Fig. 3 illustrates automatic switch-over with separate surface heating and cooling coils as did Fig. 2, but in addition most of the conditions inside can be made to vary with changes in outside conditions. The arrangement will be seen to resemble Fig. 2 in that two sets of controllers are used to sense the inside conditions—one set for summer and one for winter operation. In the main these controllers act on the valves of the coils and sprays about as described under Fig. 2. As in the control arrangement of Fig. 2, the winter and summer controllers for inside conditions must be set a few degrees apart. Similarly, the temperature controller in the duct at the right acts as a low limit control throughout the year. Action of the outdoor thermostat connected to the damper motor and thence to the outdoor and return air dampers is also exactly similar to that described under Fig. 2. The other two outdoor sensitive elements shown are to permit the indoor control points to change with changes in outdoor conditions. Their action was described in principle in the preceding article. While control of the cooling coil is shown by means of starting and stopping a mechanical refrigeration compressor, it is evident that alternative arrangements would be possible.

Fig. 4 includes surface heating and an air washer, and switch-over is accomplished manually. Besides throwing the switch by hand it is also necessary to reset the controller each time.

With the switch in the winter position the controller acts to keep steady the temperature of the air leaving the washer (dewpoint temperature) by adjusting the position of the damper motors and the valve on the heating coil. On falling temperature the controller first positions the outdoor and return air dampers to admit less outdoor air and more return air. If the temperature continues to fall the damper in front of the heating coil is positioned to pass more air over the heating coil and less around it, at the same time opening the valve to admit more steam to the coil.

In summer operation the controller likewise positions the outside and return air dampers to reduce the amount of outside air if the temperature leaving the washer rises. If the dewpoint temperature continues to rise the temperature of the spray water is reduced by admitting more cold water and less warm water through the valve leading to the sprays.

Fig. 5 is essentially similar to Fig. 4 but with provision made for automatic switch-over. There are two dewpoint temperature controllers instead of one. Each separate controller acts to keep the dewpoint temperature steady at its set point. One is set a few degrees higher than the other. For instance, the summer controller might be set at 57° and the winter one at 50°. Then the summer controller would assume control as the temperature at the washer discharge approaches 57° and the other when the temperature approaches 50°.

In Fig. 6 there is surface heating, an air washer, and a bypass duct for recirculating part of the return air past the washer. Automatic switch-over is provided.

The outdoor temperature controller at the left positions the outside air damper throughout the year. Humidity control may act in conjunction with it if desired. The controller in the discharge air duct at the right also acts as a low limit control throughout the year, operating through the heating coil valve and damper in winter and through the damper motor governing the return and bypass air quantities in summer.

In winter operation the winter dewpoint controller keeps the temperature of the air leaving the washer steady by acting on the compound damper in front of the preheater and on the valve leading to the preheater, while the controller in the exhaust duct keeps room temperature steady by acting on the damper motor which controls the relative amounts of return air passed through the washer and bypassed around it. This same controller in the exhaust duct also acts on the compound damper in front of the heating coil at the right and on the valve leading to this heating coil.

During summer operation the dewpoint controller keeps the temperature of the air leaving the washer steady by acting on the valve in the line leading to the sprays to govern the relative amounts of warm and cold water reaching the washer. The controller in the exhaust duct keeps the room temperatures steady by acting on the damper controlling the air flow.

The exhaust duct controller carries two sensitive elements and is in effect two controllers. The one which controls during winter operation is set at a lower temperature than the one controlling the summer operation. So also the low limit controller is really a double instrument so arranged that on falling temperature it causes the damper motor to admit a maximum of bypassed air and then moves the compound damper at the extreme right so that it will pass more air through the heater coil.

As in Fig. 5 the two dewpoint controllers must be set a few degrees apart. Also the plan in Fig. 6 may be used with manual switch-over, if desired.

Thermostatic Radiator Valves Modernize Insurance Building

So well have 1,500 thermostatic control valves functioned on radiators in the executive offices of the New York Life Insurance Co., New York, over a period of four years, that about 1,000 more were installed as a modernization project on other radiators in the building last summer. Practically every radiator in this building is now thermostatically operated under direct control. Test data covering the history of the initial 1,500 regulators are still incomplete but it is known that more than 10% was saved in fuel annually.

This building has its own power plant, using barley anthracite coal fired by chain grate stokers. Altogether some 125 million lb. of steam are generated yearly. The first 15 floors of the building are equipped with indirect as well as direct heating, the fans being operated for air circulation in summer and for heating in winter.

12-Story New York Apartment Installs Year 'Round Conditioning

Forty-four apartments containing a total of 253 spacious rooms are now being air conditioned in a comprehensive rebuilding of a major residential building on New York's exclusive Park Avenue. Scheduled for completion by September 1, the system will have a conditioning unit in each apartment, operating in series with a central system on the roof, with the former supplied with cooling water from a refrigerating plant in the basement. In the winter there will be direct heating from radiators, with filtered, humidified, and tempered outside air supplied for ventilation

By JOSEPH F. KERN, Jr.†

WHAT is expected to be the most modern apartment in the Grand Central Terminal Zone is now being finished at Park Avenue and 54 Street in New York. The building will house 44 spacious apartments, all of which will be air conditioned. All the bedrooms will have bathrooms attached and open fireplaces are provided in most of the living rooms and libraries.

The building was originally erected about twenty years ago by the New York State Realty and Terminal Company, a subsidiary of the New York Central Railroad Company, as the first major high class apartment house in the Grand Central Zone. It is of steel frame, fireproof construction and is 12 stories, approximately 150 ft., in height. Its total cubage is 1,524,000 and it has a gross floor area of 122,922 sq. ft.

As originally constructed there were only two apartments occupying each floor. Living rooms ranged upwards in size to 20 x 40 ft., with open fireplaces, spacious bedrooms, and maids' rooms provided in each apartment.

During the past few months practically the entire interior of the building has been torn out and rebuilt.

As rearranged, each floor has been subdivided into four apartments, all with outside exposure and utilizing the space alloted to maximum advantage. One apartment on each floor consists of five rooms and the three others of six each. There are forty-four apartments in all located on the second to twelfth floors, inclusive.

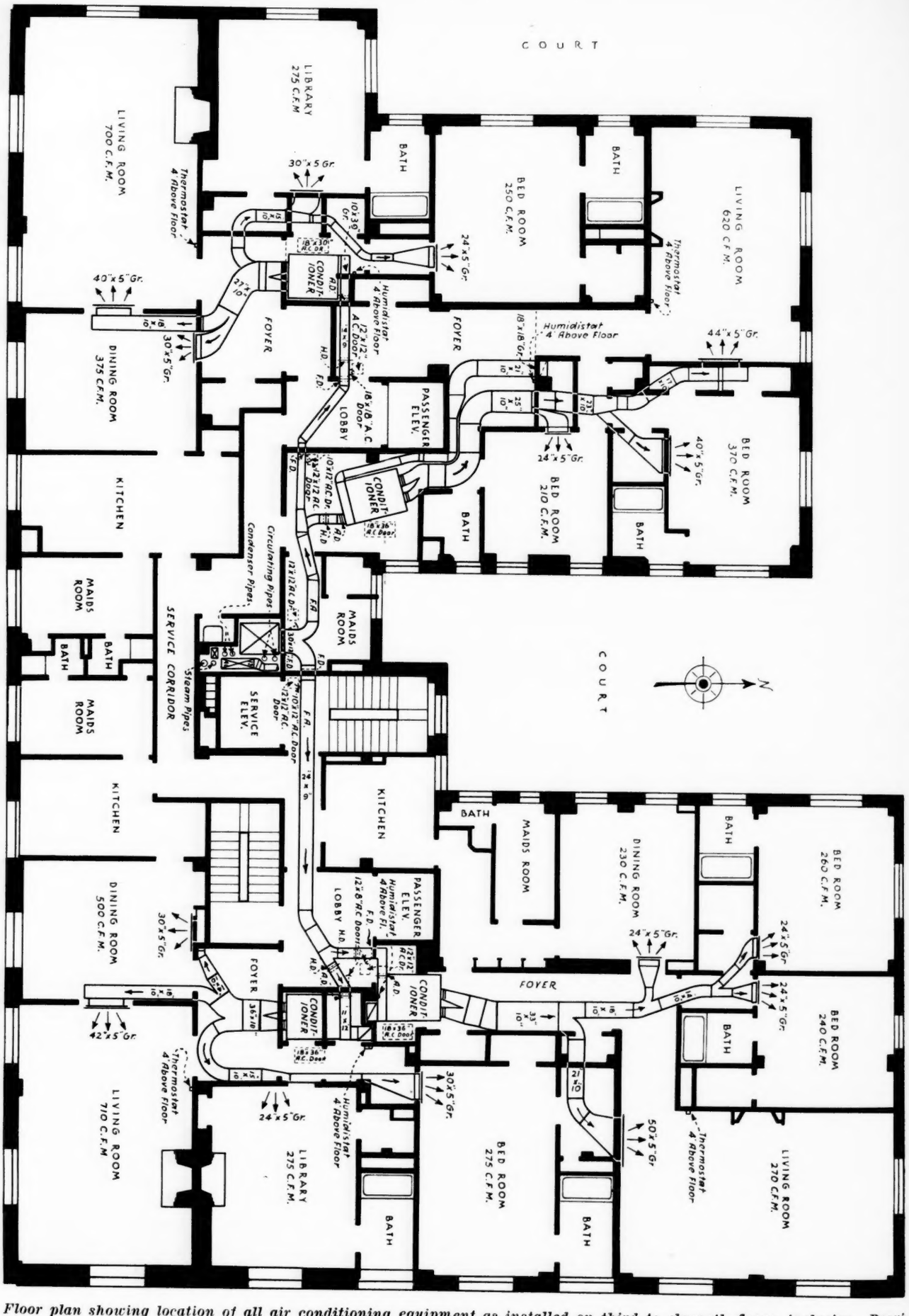
On the ground floor space is assigned to shops of an exclusive character, the fronts being finished with bronze and limestone. There is also a doctor's suite, with private entrance on 54 Street entirely separate from the apartment tenant entrance, which has a spacious lobby of marbleized material. Provisions have been made so that the doctor's suite and the stores can be air conditioned if the tenants desire it. There are also additional maids' rooms with private baths on this floor.

Below the street level there are eight laundries, equipped with tubs, driers, and ironing facilities. There are also separate storerooms for each apartment. Here, too, is service space for the heating boilers, the air cooling compressors, and other equipment used in the air conditioning system for the building.

The air conditioning system for both cooling and heating the building is made up of a number of units, one in each apartment. These units will clean, cool or heat, recirculate and furnish outside air. They are supplied with cold water for cooling the air by a central refrigerating system located in the basement and with outside air by a system of ductwork which carries the air down from an inlet on the roof. During the winter the units obtain hot water for heating from the same pipes which circulate cold water during the summer.

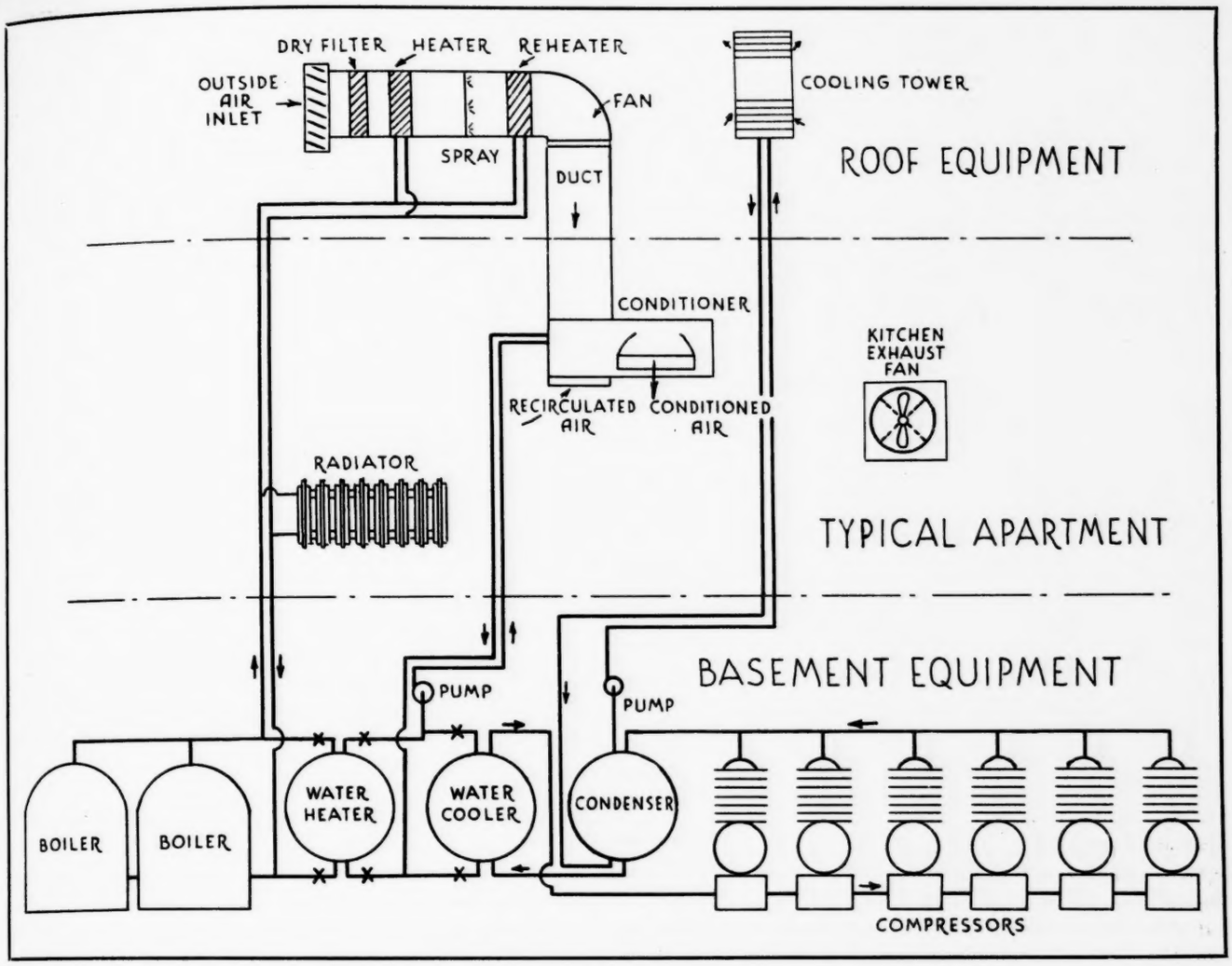
The conditioning unit for each apartment includes filters, heating and cooling coils, blower, blower motor,

†Assistant Editor, HEATING & VENTILATING.



Floor plan showing location of all air conditioning equipment as installed on third to eleventh floors, inclusive. Provisions are made in doors for the return of recirculated air through grilles where necessary.

Explanation of Abbreviations: Gr., grille; A.C., air conditioning; F.A., fresh air; F.D., fire door; H.D., hand damper; A.D., access door.



Schematic diagram of the arrangement of air conditioning apparatus. The central plant on the roof serves 44 conditioners. Six 20-ton compressors and two 105-hp. boilers are located in the basement.

drip pan, motor-operated modulated reversing water valves, and manual valves for adjusting and servicing. As the question of noise is of utmost importance, the equipment when in operation must be free from objectionable noise and vibration and is so designed that the average loudness level throughout the conditioned space due to the air conditioning system does not exceed 30 decibels above a reference level of 10-16 watts per square centimeter, as measured by a noise or sound meter, meeting specifications of the American Standards Association. To accomplish this, low fan speeds are used and all discharge ducts are lined with sound absorbing material. The units are designed to furnish not less than six air changes per hour to the spaces conditioned. Individual temperature and humidity controls are furnished for each apartment, and each unit when used for cooling is designed to maintain the conditions in the conditioned spaces with outside conditions as shown in the accompanying table. These indoor dry bulb temperatures are maintained within 2°, plus or minus from the set position of the thermostat, and the relative humidity indoors is designed not to exceed the above values by more than 2%.

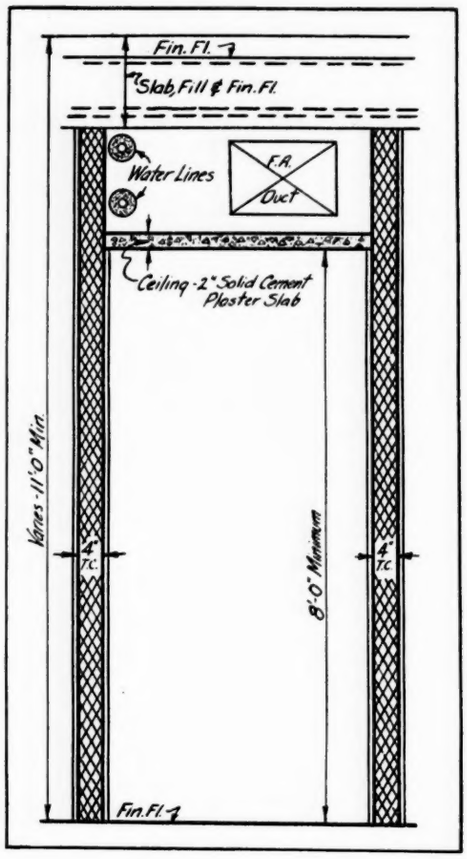
Outside Temperature, °F.		Inside Conditions, °F.	
Dry Bulb	Wet Bulb	Dry Bulb, °F.	Relative Humidity, %
92	75	80	45
87	75	78	50
82	75	76	55
77	75	74	60

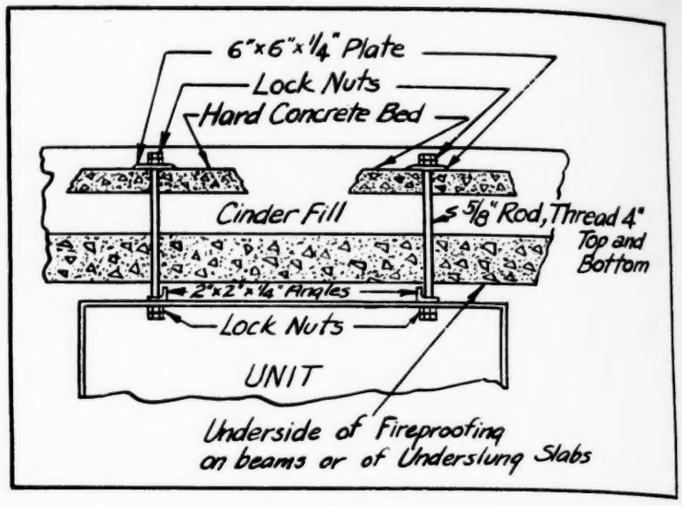
The operation during the summer is as follows:

Outside air is drawn in through the roof inlet, filtered, and forced into the distribution duct by a variable speed fan. The static pressure of the air within this duct is held constant by means of a pressure control. When the air conditioning units demand more outside air the static pressure falls, and the pressure control increases the speed of the fan to restore the pressure within the duct.

There is a fan in each of the air conditioning units which runs at a constant speed, thus a constant amount of air passes through this unit at all times. However, the amount of outside air entering each unit varies according to the position of the dampers in the outside and recirculating ducts.

The dampers operate as follows: As the temperature within the apartment rises, increasing the cooling load on each unit, more air is recirculated and less outside air admitted. As the temperature falls the room thermostat closes the recirculating damper and opens the out-





(Left) Typical cross section through service corridor showing fresh air duct and cold water lines in space above false ceiling. (Above) Detail of method of supporting air conditioning unit from ceiling.

side air damper, allowing more outside air to enter the apartment. A minimum amount of outside air is always supplied to the apartment because the exhaust fan located in the kitchen runs at a constant speed throughout the entire year, withdrawing air which must be supplied by the outside air duct.

Conditioned air is discharged into the rooms through directional grilles and in each discharge duct individual manually-operated registers are furnished which permit the tenant to completely shut off conditioned air in any room and be able to maintain conditioned air in the other rooms. It is felt that this will prove advantageous in case the tenant wants to supply conditioned air only to the bedrooms.

The placing of the air conditioning units required a considerable amount of detailed study in order to determine the best location and still give sufficient headroom, for all units are placed in the ceiling and are supported from the floor above. The locations of these units are such that servicing can readily be made with the minimum of disturbance to the tenant. In order properly to balance the amount of fresh air and recirculated air, separate exhaust fans with speed control are placed in each kitchen.

For winter operation the outside air is preheated, humidified, and filtered at a central conditioner on the roof. The humidity of the air is controlled by a dew-point thermostat, located between the spray chamber and the reheater, which regulates the amount of steam flowing to the preheater. The air is reheated to about 70°, and then passes through the fan to the duct. It is then taken into the individual conditioners in each apartment where it is mixed with the recirculated air and, after being cleaned or heated, is distributed into each room. The air enters the rooms at a temperature between 70° and 80°, a thermostatic control regulating its temperature. However, most of the heat load of the building during the winter is carried by recessed radiators.

The cooling equipment is located in a separate room in the basement and consists of six 20-ton compressors, two large water coolers, condensers, and the necessary pumps to force the cold water or hot water through the circulating system. The temperature of the cold water is held constant during the summer. As the temperature of the water tends to rise, due to an increased cooling load, more compressors are put into operation, for at any one time only enough compressors to carry the load are in operation, thus assuring a maximum efficiency. Condenser water for cooling the compressed refrigerant is obtained from a 200-ton cooling tower located on the roof.

According to the present plans, the cost of operating the air conditioning system will be divided among the tenants and the management. The cost of operating the fan on the roof, refrigerating compressors, and heating boilers will be borne by the management while tenants will pay for electricity used by the fan in the air conditioning unit and the exhaust fan in the kitchen. It can be easily seen that the management will bear the major cost of operating the system and the tenants' costs will be comparatively small.

It is believed that if the tenant has to pay a portion of the operating cost he will not be so careless about allowing the system to run when it is not needed.

Yearly rents for the apartments range from a low of $2,500 for a five-room, three-bath suite to $5,000 for a six-room, three-bath suite in a preferred location. The average rental asked is about $3,500. A large number of inquiries have been made by prospective tenants since it was announced that the building was to be air conditioned. From present indications it is believed that practically all of the apartments will be rented by the time the work is completed September 1

Air Conditioning Aids Utility Employes

By LESLIE S. TARLETON†

THE Philadelphia Electric Company, in common with many of the other leading utilities of the country, has been quick to recognize the beneficial results of air conditioning upon their employes, and consequently for the past few years has been carrying on a steadily increasing program of air conditioning installation in its own buildings. Naturally, these installations are being made in those quarters where the needs are the most pressing.

An interesting system recently completed has been placed in a portion of the building located at 23 and Market Streets, Philadelphia. The conditions are unusual in that there is no external exposure whatsoever.

Probably few of the company's employes lead as harrowing an existence as the work and trouble dispatchers. They are in direct contact with exasperated members of the public who are not concerned with causes or excuses, but are interested in only one thing —prompt action. Obviously, where there is such continual strain on the nervous system, it is imperative that all other working conditions be made as nearly ideal as possible. With this in mind, the company conceived the idea of setting up a suite for this group which would be as free from noise, dirt, and personal discomfort as was reasonably possible.

The building in question is of the warehouse type, and the space selected is well toward the center of the third floor, in order to be removed from the street noises. Excellent illumination was provided and a year 'round system of air conditioning installed, which was designed for 24-hr. continuous service.

An assembled conditioner was installed in an assigned room adjacent to the conditioned area, this unit containing washable bronze mesh filters, humidifying sprays, heating coils, direct expansion cooling coils and a multiblade fan and motor. Refrigeration is provided by a reciprocating compressor near the conditioner.

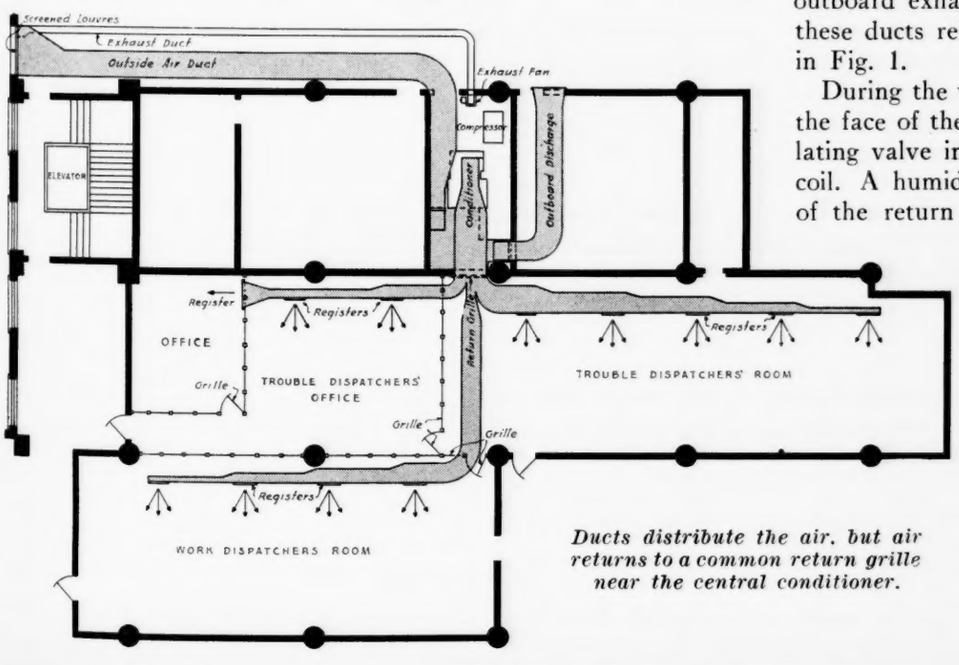
Outside air is taken from one of the exterior windows at the front of the building, and brought through ductwork to the unit. Capacity is provided in the intake duct equal to the full fan capacity of the unit, in order that cooling in mild weather may be accomplished without the use of mechanical refrigeration. Conditioned air is distributed to the conditioned area through horizontal ductwork, neatly installed close to the ceiling and exposed. Bar type directional throw grilles are used, giving an even distribution of air. All returns are brought back through grilles in the partitions or doors, utilizing the rooms themselves as return ducts. A large return grille in the partition between the equipment room and the conditioned area conducts the return air directly into the unit. Inasmuch as quiet is a requisite of the system, it was necessary to treat this return chamber acoustically to prevent equipment noises from working back through the return grille. This was effectively accomplished by lining the return duct with acoustical felt, and likewise providing felt baffles, placed vertically in a staggered arrangement in the duct.

Recognizing that at times when 100% of outside air is used some means of pressure relief must be provided, a free discharge duct was provided so that the excess air may escape from the area to the balance of the floor, thus creating an outboard exhaust.

Automatic control is of the pneumatic type and is designed with a view to effectiveness and simplicity. Three automatic dampers are provided, one in the outside air duct, one in the return duct, and one in the outboard exhaust duct. The arrangement of these ducts relative to one another is shown in Fig. 1.

During the winter, a thermostat located on the face of the return grille controls a modulating valve in the steam line to the heating coil. A humidity controller also on the face of the return grille controls a valve in the spray line to the humidifier. These humidifier sprays would normally be connected to a cold water source, but owing to the fact that there are no outside exposures with which to contend, and hence no possible condensation problems in cold weather, this connection was made to the service hot water system, in order that winter relative humidities of 50% may be

†District Engineer, Peirce-Phelps, Inc., Philadelphia.



Ducts distribute the air, but air returns to a common return grille near the central conditioner.

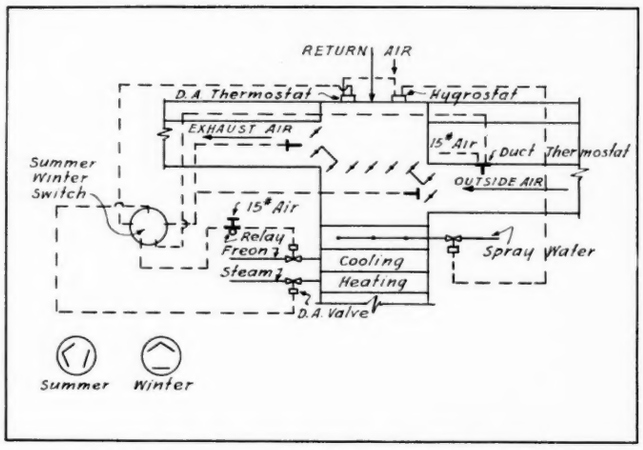
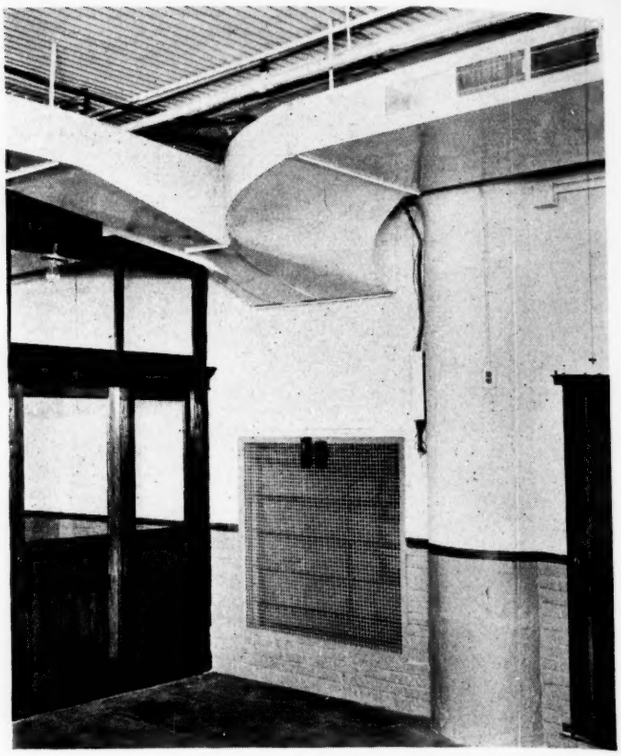


Fig. 1. Arrangement of ducts and positions of automatic controls.

readily secured. In mild winter weather, with the steam valve closed, should the temperature continue to rise owing to the internal heat gain, the outside air damper opens with modulated action, thus holding the room temperature at its predetermined setting. With increased opening of the outside air damper occurs a simultaneous increased opening of the outboard exhaust damper and a decreased opening of the return air damper.

In summer, the same thermostat will control a pneumatic valve in the liquid refrigerant line to the cooling coil, thus shutting down the compressor when the proper temperature is reached by means of the low pressure cutout, and restoring the operation of the compressor upon a rise in temperature by opening the liquid line valve. Furthermore, should the outside air temperature fall below a predetermined setting, the outside air damper will be opened full and, concurrently, the outboard exhaust will be opened full and the return damper closed. Thus, as far as is possible the control is arranged to take full advantage of outside air cooling, in both winter and summer, and save the use of mechanical refrigeration.

In actual operation, the system requires considerably more hours of compressor operation than the average installation, owing to the amount of internal heat gain.



Main supply trunk and return inlet. Note controls mounted on face of return grille.

Furthermore, the settings of both hand and automatic dampers had to be accurately determined, because an excess of outside air in severe winter weather tends to create drafts at such time as the steam valve is closed, owing to the temperature of the incoming air being too low. Some statistics of the system are as follows:

Design Conditions

Summer	exterior	95° D.B. — 78° W.B.
Summer	interior	80° D.B. — 50% R.H.
Winter	exterior	0°
Winter	interior	70° D.B. — 50% R.H.
Refrigeration capacity		10 tons
Compressor motor		10 hp.
Air circulation		6000 c.f.m.
Fan motor		2 hp.
Minimum outside air circulated		800 c.f.m.

Sun Heat Greatest on Mountains

THE sun shines hottest on high mountain tops. Observations of solar radiation from the summit of Mount Aunconquilcha, Chile, nearly four miles above sea level, and where the solar radiation intensity is nearly one-sixth again as great as at sea level, have just been reported to the Smithsonian Institution. Delicate radiation-measuring devices were carried to this crest at nearly 20,000 ft. in the highest Andes, by C. P. Butler, where he got readings intermediate between those obtained at sea level and those secured on loftiest balloon flights.

The instrument used in the measurements was set up on a cake of ice. Although, of course, the result was to be expected, it seemed a little incongruous to be suffering from the cold and at the same time measuring solar intensity far greater than that which would have been recorded in the hot desert far below.

The intensity of the solar radiation rose from 331 B.t.u. per sq. ft. per hr. at sea level—determined by numerous measurements in the past—to approximately 376 B.t.u. per hr. per sq. ft. on the top of Mount Aunconquilcha. This tends to verify the estimates of changing solar radiation intensity in direct relation to altitude, deduced from the other Smithsonian data.

Cross Connecting Two Unit Conditioners Permits Flexibility in Modernized Grill

SEPARATE conditioning units—one for outside air and one for recirculated air—with a trunk duct between them, are a useful means of securing flexibility in operation at the modernized grill room of the Moose Club, in Erie, Pa. This modern grill, measuring 40 ft. by 120 ft. x 9 ft., requires two 15-hp. refrigeration compressors and, according to Terry Mitchell, Frick Company, the arrangement at the air handling units is the most distinctive feature of the installation.

Unit A in Fig. 1, which handles fresh air, has eight rows of tubes of direct expansion cooling coils and also both a tempering unit and a heating coil for winter use. At maximum it handles 2,500 c.f.m. and delivers its air along the north wall of the grill room, directly under the ceiling.

Unit B, for recirculated air, has a maximum capacity of 3,500 c.f.m., has six rows of tubes in its cooling coil, and a heating coil but no tempering coil. It delivers its air along the south wall of the grill room, directly under the ceiling. The return duct runs along the floor as shown in the illustration.

The function of the common duct (shaded on the drawing) is to adapt the air quantities to the requirements. It is not an automatic bypass but simply a trunk between the two units, with a hand-operated damper as shown. The damper permits feeding some recirculated air to Unit A, or some outside air to Unit B as necessary. Dampers in the main ducts assist in making this adjustment. The amount of outside air can be varied from zero to 80%.

Steam is available at all times from a main under the street, although it is used only in winter or in cool weather. If the weather moderates to the extent of exceeding 70°, the automatic controls bring the refrigeration into play. If the room temperature rises too high the refrigeration may be used, especially on the recirculated air unit, even though the outside air temperature is between 45° and 55°.

Compressors are connected to common suction and liquid lines, and the crankcases and receivers are equalized.

Operating control can be summarized as follows:

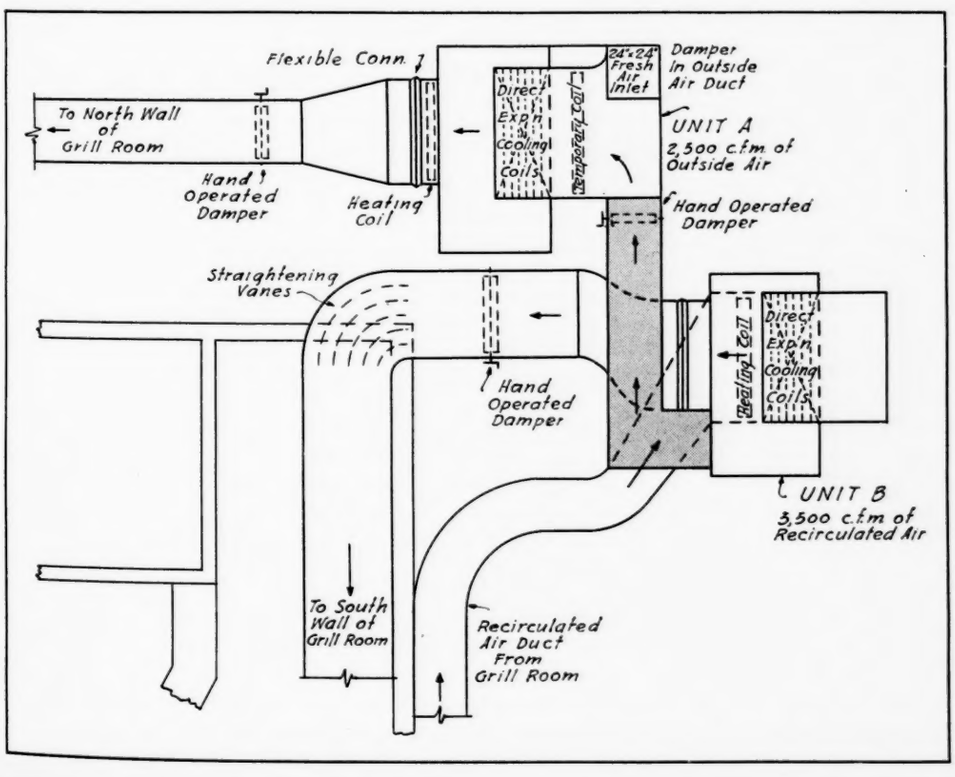
1. If the room temperature is 80° or above, both conditioning units start operation, and one of the refrigerating machines is started. This machine is connected to cooling coils in each of the units.

2. The other refrigerating machine begins operating when the suction pressure builds up to 42 lb., this machine being controlled entirely from a pressurestat.

3. If the relative humidity is greater than 50% when the dry bulb temperature is between 75° and 80°, the first machine starts by a humidistat. If the heat load is very light, this machine is prevented by its own pressurestat from continuing to run until the cooling coils are frosted.

4. When it is a cool day outside and there is a large and active crowd in the room, the equipment can automatically shift from heating to cooling. Two thermostats are set to turn on the heat in steps, at 70° and 72°. If the temperature rises to 75°, the heat is shut off and, provided the humidity is high, one refrigerating machine then starts; otherwise, it does not start until the temperature reaches 80°.

Temperatures may be held at different levels desired by adjusting the control instruments and maintaining the same relative difference between instruments.



One unit for outside air, another for recirculated air, a bypass between them, gives operating flexibility at the Erie Moose Club. Shaded portion shows the duct whose function is to adapt air quantities to the requirements.

WHAT READERS SAY . . .

Attic Heat Loss

I have followed the series of articles on "Getting Down to Fundamentals" with much interest.

In article 10 values for "U" were given for combined roof and ceiling when the ceiling is attached to the underside of the roof rafters. I would like to know a method of figuring the heat loss through a ceiling of a top floor room and an unheated attic that is closed. My ASHVE Guide gives a formula but does not take into consideration the wall space of the attic necessary to close the gable end of the roof.

The formula given is:

$$U = \frac{U_r \times U_{ce}}{n \times U_r + U_{ce}}$$

I would also like to know an accurate method of determining the heat loss from a basement that is partly above ground.

Trenton, N. J. J. W. O.

We are sending you two sheets, one of which outlines a method for computing the heat loss from an attic, and the other outlines a method of computing heat loss from a basement partly above and partly below the ground.

Both these explanations are rather long, and in the great majority of cases a detailed calculation is not necessary. However, we believe that in both cases if the estimate you are preparing really justifies going to the length of making as accurate an estimate as possible, then you will find that these two methods are useful.

In both cases common practice is to make an assumption which is probably justifiable in a good many calculations. In calculating heat losses through roof and ceiling combinations the assumption is commonly made that the temperature in the attic is midway between the temperature of the outside air and the temperature of the inside air. Then the heat lost through the ceiling area at this difference in temperature is computed.

In computing heat losses from basements a common assumption is to assume that all the ground in contact with the basement walls is at a temperature of 50°. For a good many cases this is sufficient for practical purposes.

•

Psychrometry at 3,000 Ft.

The — Company informs us that there is a psychrometric chart for high altitudes in the March issue of HEATING & VENTILATING. Does this chart give the moisture content in grains per cubic foot or grains per pound for an altitude of 3,000 ft.—the total heat above 0° contained in 1 lb. of dry air saturated with moisture at that altitude? Will a cubic foot of air at this elevation hold as much moisture as it will at sea level? Our manual states that the quantity of water vapor that can be mixed with air depends upon the temperature and is independent of the pressure. Does this mean the water vapor per cubic foot or the water vapor per pound?

Reno, Nev. J. P. B.

The general psychrometric chart by J. S. Chandler in our March issue deals with both high and low altitudes. It gives the moisture content in grains per cubic foot per pound of dry air, and the enthalpy, or heat content, in a pound of dry air at the altitude you speak of—3,000 ft.—which has a standard barometric pressure of 26.68 in. of mercury.

You will note that the chart does not contain the full 26-in. pressure line. However, since all the lines on the right-hand part of the chart are straight lines, you can cut the chart apart and draw in additional lines if you desire.

Your manual is correct in saying that the quantity of water vapor that can be carried by air depends on the temperature, and is independent of the pressure. In this connection, however, it means the water vapor per *cubic foot*. You will note from solving a typical example on the chart that the water vapor which can be carried by a *pound* of dry air does change with the barometric pressure.

•

Smoke Bombs

Can you inform us what is used to make smoke tests for air distribution in ventilating systems, and if "bombs" for this purpose are manufactured where they are procurable?

Winnipeg, Canada. H. C. C.

There are several kinds of these bombs. A bomb releasing white smoke and commonly used indoors is available, as is also one using a yellow smoke. Bombs of either of these types can be purchased in ½-min. or 1-min. bombs. There is also a bomb which releases a black smoke, available in bombs having a time interval of ½-min. to 5 min. These bombs are a standard article, and you can get quotations, additional information, etc., from Pains Fireworks Display Co., 22 Park Place, New York, N. Y.

•

Hospital Air Conditioning

Will you send me a list of articles published in your magazine on air conditioning of hospitals, and oblige,

New York, N. Y. J. O. A.

Following is a list of articles in HEATING & VENTILATING since 1930 on hospital buildings. We especially call your attention to the article by Mr. Neergaard in the January 1934, issue.

Application of Air Conditioning to Premature Nurseries in Hospitals, Yaglou, Drinker and Blackfan, August, 1930 page 87; *Air Conditioning Special Hospital Rooms*, G. T. *Shoosmith*, April, 1931, page 88; *Piping Details in Hospital Building*, G. Kendrick Bringhurst, October, 1931, page 41 *Engineering Economics in Hospital Buildings*, Chas. F. Neergaard, January, 1934, page 9; *Sanatoriums and Hospitals Must Control Inside Weather*, November, 1934, page 21; *Report of Committee on Air Conditioning of American Hospital Association*, February, 1935, page 49; *Hospital Provides Facilities for Future Air Conditioning Units in New Building*, May, 1935, page 22; *Ultra-Violet Rays May Play Important Part in Hospital Air Conditioning*, October 1935, page 27.

•

Thanks; We Will

. . . you have a very fine magazine. The features are both interesting and valuable. Am placing the blue data sheet in a file for handy use. Your page "What Readers Say" a good idea. I hope you continue it.

Chicago, Ill. I. A. B.

Heat Capacity of Tubing

Will you please send me charts of square feet of heating capacity on copper tubing according to different sizes of copper tubing per linear foot, so that it will be easier and quicker to determine what size copper pipe to be used for heating up, such as water and other liquids in storage tank heaters; also the square foot of heating liquids from and to degrees F.

New Orleans, La. J. K. W.

We do not have any charts of the kind you mention. Neither do we know of charts which show this information specifically for copper tubing. However, there are some charts which show values for copper and brass piping of various standard sizes, and it is possible that this information will be close enough for your purpose.

The best information we know of in this connection appears in the book, "Engineering Data on Flow of Fluids in Pipes and Heat Transmission," published by Crane Co., 836 S. Michigan Ave., Chicago, Ill. This book is priced at $1. The material to which we refer appears on pages 57, 58 and 59 of this pamphlet, which, by the way, is one of the best we have ever seen in connection with heat transfer problems.

Another place where there is a similar table is in The Ideal Fitter put out by American Radiator Company, 40 W. 40 St., New York City. A table in this book gives the heating power for brass pipe in water storage tanks. This table does not give the variations of heat transmission with pipe diameter, but we believe it is sufficiently accurate for your problem.

•

100,000% Efficiency?

In conjunction with the air conditioning classes conducted by Mr. Herman of the Furblo Company, under the auspices of the Milwaukee Sheet Metal Association, at the Builders Club, the subject of increased efficiency in a warm air heating plant, caused by the addition of a blower, brought about a discussion of properties of the human body as a heat generating unit.

The duties of the Army Mess Officer, in the calculation of a balanced ration, might easily earn the title of Eating Engineer, as the U. S. Government has issued Food Specifications for every component of the ration, and the vitamins and calories are carefully calculated as a heating engineer would calculate his B.t.u.'s . . .

A careful analysis of fuel for a soldier amounts to 2,520 calories, or 10 B.t.u.

The daily heat emission is as follows:

4-hr. drill	700 B.t u. per hr.	2,800
4-hr. instruction	450 B.t.u. per hr.	1,800
8-hr. recreation	400 B.t.u. per hr.	3,200
8-hr. sleep	300 B.t.u. per hr.	2,400
Total Heat Emission		10,000 B.t.u.

With an input of 10 B.t.u., the human body emits 10,000 B.t.u., or a ratio of 1 to 1,000, which is a goal for any heating engineer.

Perhaps the doctor can tell us how this miracle is performed and give us a formula that will enable the heating engineer to perform miracles in the heating of buildings.

Nashotah, Wis. E. F. F.

The difficulty probably lies in the fact that the 2,520 calories in the garrison ration which you mention is in terms of large calories instead of small calories, as you have assumed. While we have not specifically looked up the point, most writers on food and dietetics mean by the word "calorie" the large calorie, which is equal to 1,000 small calories. That being so, the garrison ration contains not 10 B.t.u., as you have assumed, but 10,000 B.t.u. You will note, then, how closely your estimate of the daily heat emission agrees with the input fixed by standard ration.

Design Temperature

Since writing to you I have talked to a number of designers both in Terre Haute and Indianapolis. They all say that they use a design temperature of —10° for Terre Haute.

In your answer to my letter you said, "Terre Haute being farther south than Indianapolis would apparently have a higher design temperature than Indianapolis, which it does . . . . ."

This statement is not correct as Indianapolis has a higher design temperature given in the table than does Terre Haute. It is given as —5° for Indianapolis and —10° for Terre Haute.

Terre Haute, Ind. A. F. W.

•

"U" and "K"

Is the "U" in your new series of Heat Transfer Tables the same as the old "K"?

Greenville, Mich. M. G. K.

Yes.

•

Blower Mounting

The announcement carried on page 66 of the April, 1936, issue is incorrect. Specifically to quote: "A feature of the unit is the mounting of the blower in the space *above* the combustion chamber."

The blower is not placed in the space above the combustion chamber. There would be nothing of an unusual value in doing this and it would not be a new development in the air conditioning field. Actually, the blower is placed inside the combustion chamber and directly over the fire where its surface is exposed to the radiant heat of the fire . . . This is an improvement and an outstanding claim made by our company . . .

Robeson Engineering Co., Inc., East Orange, N. J. B. P. Robeson

•

Books

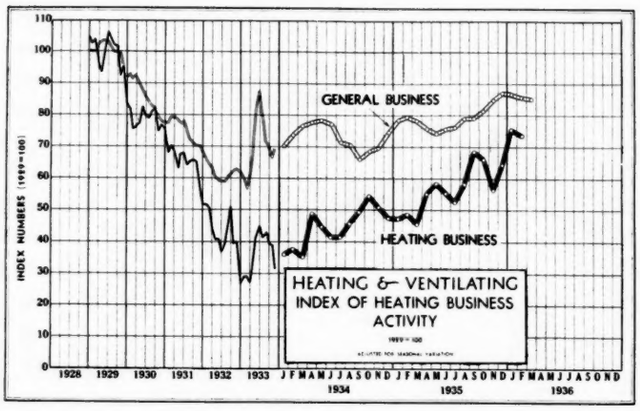
In Heating & Ventilating there appeared several months ago a review of a book on heating installations. The reviewer mentioned the fact that the author in discussing the question had kept in mind the owner's point of view . . . I would like to know the name of the book and where it might be purchased. . .

Real Estate Dept.
Fidelity-Philadelphia Trust Co.,
Washington, D. C. F. C. F.

We have been unable to locate any book reviewed recently in our magazine which discusses the subject of heating installations from the owner's point of view. However, if you are looking for a book which would give more or less non-technical information on heating systems, we recommend "Mechanical and Electrical Equipment for Buildings," by Gay & Fawcett, published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, price $5. This book covers all types of mechanical and electrical equipment usually installed in buildings, and treats all these subjects from a semi-technical standpoint.

•

Readers who make use of the Degree-Day unit are urged to refer to page 31 on which is announced the HEATING & VENTILATING DEGREE-DAY COMPETITION with $160 in prizes.



Heating Business in February 73.3% of 1929

THE second month of 1936 closed with the physical volume of business done by the heating industry approximately at three-quarters of 1929 levels, as compared with a level of about 50% for February, 1935. In other words, the heating industry in general has increased its volume of business approximately 50% in the last year. Meanwhile, the automatic heating business—oil burners, stokers, and gas burners— was 132% of that in 1929, as compared with 75% for February of 1935. The sharp increase in this business is accounted for by large gains in both the stoker and oil burner businesses.

This is the first month since the January issue that HEATING & VENTILATING has published its indexes which usually appear on these pages each month. The absence of these figures from the past few issues has been due to a revision necessitated by correction of a number of figures into which errors had crept, most of which were in the oil burner figures where many natural draft burners had been reported as such when they really should have come under the classification of distillate burners, and which are not used in these indexes, since they are used primarily in cooking. Taking these data out reduced the indexes to some extent, and the revision went back as far as January, 1934. For the convenience of readers who follow this index, the revised figures for 1934 and 1935 for both the heating index and the automatic heating index are given below.

New building in March was at 34% of 1929 levels, after correction was made for seasonal variation, as compared with 19% in March, 1935.

The accompanying table shows the trend of business both in the indexes and in equipment sales. Practically all of the equipment items on which figures are available showed gains in February, as compared with the

(Concluded on page 79)

HEATING AND AIR CONDITIONING BUSINESS TRENDS

Indexes (1929 = 100)	February, 1936	February, 1935
HEATING & VENTILATING'S Index of Heating Business	73.3	48.6
HEATING & VENTILATING'S Index of Automatic Heating	132.0	75.4
HEATING & VENTILATING'S Index of Contractor Activity	61.3	41.4
Indexes (1929 = 100)	**March, 1936**	**March, 1935**
HEATING & VENTILATING'S Index of New Building	34.0	19.0
HEATING & VENTILATING'S Index of Stock Prices	79.8	30.0
Equipment Sales	**February, 1936**	**February, 1935**
Mechanical draft oil burners, number of units	5,278	3,145
Oil burner-boiler units, number	359	231
Oil burner-furnace units, number	230	40
Blowers for public buildings, dollars	105,753	29,181
Small housed blowers, dollars	65,687	42,977
Propeller fans, dollars	136,360	61,110
Unit air conditioners, self-contained, dollars	76,582	—
Unit air conditioners, other, dollars	192,763	—
Central air conditioning systems, comfort, dollars	569,122	—
Central air conditioning systems, industrial, dollars	35,477	—
Refrigerating medium for air conditioning, dollars	103,282	—
Air filters, unit type, dollars	15,074	—
Humidifiers, dollars	79,401	—
Air washers, dollars	39,746	39,685
Unit heaters, dollars	367,197	211,057
Unit ventilators, dollars	216,401	67,521
Cast iron radiators, thousand sq. ft.	3,086	2,787
Steel boilers, number	453	163
Stokers, class one, number	2,342	1,113
Stokers, class two, number	167	107
Stokers, class three, number	71	48
Indirect heating surface, non-ferrous, dollars	117,228	59,210
Indirect heating surface, cast-iron, dollars	9,217	10,042
Non-ferrous convectors, sq. ft.	182,815	108,605
Cast iron convectors, sq. ft.	223,077	66,093
Round boilers, thousand pounds	2,437	2,494
Square boilers, thousand pounds	11,955	9,275

REVISED FIGURES FOR HEATING & VENTILATING'S INDEX OF HEATING BUSINESS ACTIVITY
(1929 = 100. Adjusted for Seasonal Variation)

Month	1934	1935	1936
January	36.2	47.0	75.4
February	37.7	48.6	73.3
March	35.1	45.5	—
April	48.7	55.0	—
May	44.8	58.3	—
June	41.4	55.4	—
July	41.4	52.6	—
August	45.7	58.3	—
September	49.3	68.3	—
October	54.3	66.0	—
November	50.8	56.5	—
December	47.2	64.2	—

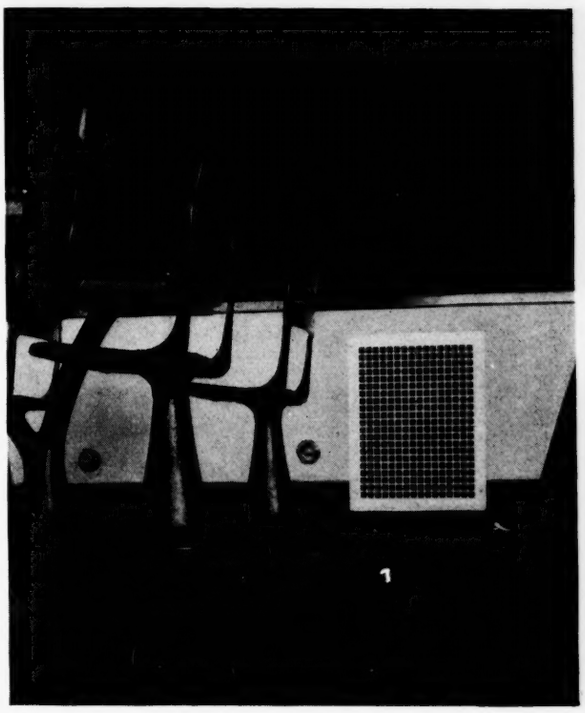
REVISED FIGURES FOR HEATING & VENTILATING'S INDEX OF AUTOMATIC HEATING
(1929 = 100. Adjusted for Seasonal Variation)

Month	1934	1935	1936
January	48.1	80.0	136.6
February	44.4	75.4	132.0
March	65.1	78.0	—
April	73.4	104.4	—
May	78.9	110.8	—
June	66.4	121.5	—
July	54.8	94.8	—
August	66.1	102.6	—
September	66.9	122.0	—
October	65.4	118.4	—
November	72.1	99.7	—
December	68.4	106.3	—

Setting Dampers for Split System Control

By E. O. YOUNG† and FRANCIS A. WESTBROOK‡

OUR experiences in setting the dampers in the ventilating ducts in a Cleveland, Ohio, high school so that the specified air velocities were secured are interesting in that they show how carefully the adjustments must be made and how necessary it is to make reliable tests. As the system referred to is a split system, use of dampers was necessary to secure proper ventilation. Approximately five hundred were installed at as many openings. It will be seen that the adjustments necessary to secure and maintain the air velocities which were prescribed in the specifications were extensive and painstaking. Furthermore, when the dampers were once properly set, it was equally necessary to provide some means of locking them in position so that they could not be tampered with. Otherwise the balance of the system would be upset even if only a small percentage of the dampers were changed.



Device for adjusting and locking damper is shown to left of the grille

Approximately 150 tons of galvanized sheet iron were used in the extensive duct systems. The supply risers lead from a concrete sanitary duct in the basement where the supply fans are located. The exhaust ducts converge into trunk ducts placed over a suspended ceiling on the top floor, and the exhaust fans are in the penthouse. The five hundred dampers were placed in the openings from these ducts and each damper was equipped with an adjusting and locking device with an indicator and dial to show its position. The device is operated by a special polygonal wrench, and it is mounted on the wall near the grilles, as shown in the photograph. The method of mounting is indicated in the diagram.

As is becoming more and more customary with such installations, the specifications call for a written report of the tests made to determine whether the air velocities called for are actually being obtained at each of the grilles when the job is turned over to the owners, in this case the Board of Education of Cleveland. In fact, unless such a report is made showing that the adjustments have been made as required and as indicated by anemometer test, the whole subject is mostly guesswork, and is likely to be a poor guess.

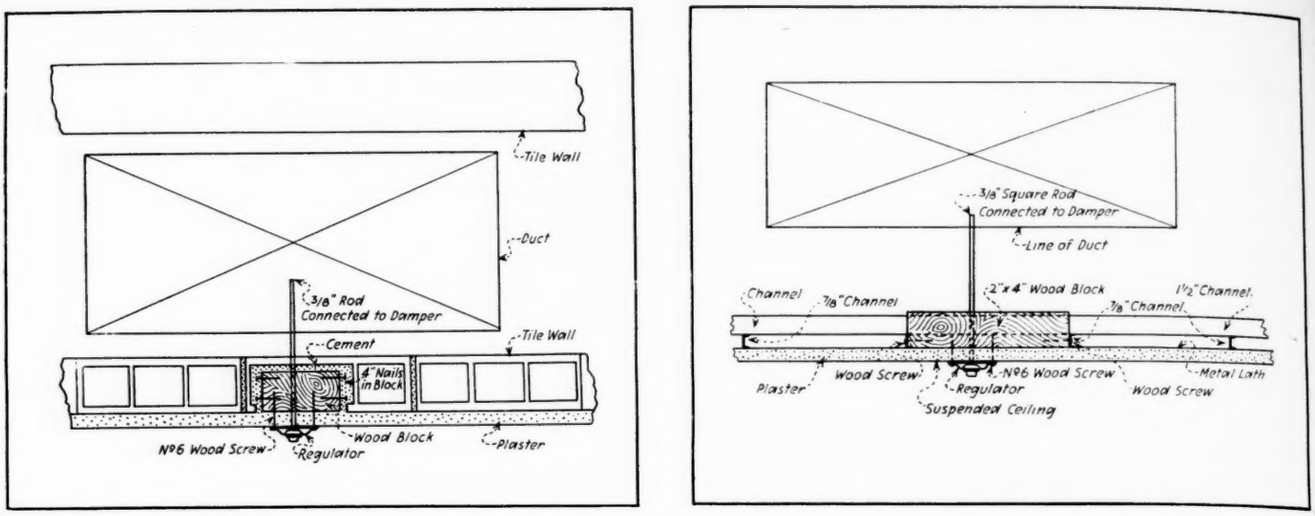
Before starting the adjustment of the dampers we prepared test sheets similar to the sample shown. The figures for the sizes of the heating and ventilating grilles and the required air velocities at each grille were taken from the architect's specifications. The actual velocities were the anemometer readings. If these velocities were within 10 to 20% of the required velocities we considered that the damper adjustments were satisfactory.

Two men were employed to make the tests and adjustments, and before they got the system properly balanced they had to go over the entire building six times. They started at the top floor and worked to the bottom. On the second round they got an entirely different set of readings from the first. That is, the later adjustments disturbed those made at the beginning of the same round, and the only thing to do was to keep on going around until by degrees a balance was established. It was a laborious job, and took two men seven weeks to get the right adjustment. Naturally, it is extremely necessary to control the setting of

†President, The Young Ventilating Co., Cleveland, Ohio.
‡Consulting Engineer, Conway Center, N. H.

SAMPLE TABULATION FROM TEST SHEET

Room No.	Size of Supply Grille	Grille Area, Sq. Ft.	Free Area of Grille, Sq. Ft.	C.F.M.	Required Velocity	Actual Velocity
Before Dampers Were Set						
106	14 x 26	2.52	1.76	500	282	600
317	14 x 26	2.52	1.76	500	282	75
After Dampers Were Set						
106	14 x 26	2.52	1.76	500	282	285
317	14 x 26	2.52	1.76	500	282	280



(Left) Method of fastening regulator to wall surface. (Right) Method of fastening regulator to suspended ceiling.

the dampers by means of an indicator which shows how they stand and which can be locked in place so that they cannot be tampered with later, and all this laborious work undone. The cost of making these adjustments and the installing of the locking and indicating regulators should always be provided for in the specifications and be allowed for in the estimates, otherwise trouble is sure to result with the contractors.

The dampers were made of sheet metal plate of 20 or 22 gage iron, and of a size to leave a clearance from the walls of the ducts of approximately ⅛ in. all around. The regulators were mounted as illustrated. We used a ⅜-in. square rod, rounded at one end, attached to the damper by means of U-bolts and of a length equal to the length of the damper plus allowances for extending through the bearing surface in the duct at one end and for attachment to the regulator at the other end. Another method of volume control which we sometimes use, but which is much more expensive, is a louver damper in the duct and so made that all the blades operate together. Structurally, this is probably more solid than the ordinary damper and probably more delicate adjustments for volume control can be made with it, but as a general thing its advantages do not warrant the extra cost. The locking and indicating regulator is used in the same way.

Another practical point relating to the construction of duct systems is that the ends of all risers should be covered to prevent them from being clogged with rubbish. This is really serious, for it is not uncommon to see a workman, after finishing his lunch, throw the paper and box into a duct opening. In one case a water bucket was thrown down a 12 x 15 in. riser. It landed at an elbow and it was necessary to hire a mechanic to cut a hole through the tile wall and the galvanized iron riser to get it out.

On another split system job where the supply ducts lead from a plenum chamber, the bottom of every supply riser had to be opened at the elbow to remove the rubbish which had been thrown in from above and had collected to such an extent that it was impossible to get a clear passage of air. Obviously, with the rather delicate adjustments called for to provide the required velocities of air at each grille, it is essential to have the ducts clear of rubbish so that the flow of air will be according to the design of the system.

Fuel Costs Cut 20% by Storm Windows and Doors

THERE is a possibility of saving approximately 20% in fuel costs in the heating of a frame building by the installation of storm windows and storm doors, according to the findings of Prof. A. P. Kratz and S. Konzo of the University of Illinois, in a study made at the research residence at Urbana. The investigators also found that there is a reasonable agreement between the fuel saving effected by storm windows and doors as computed from the calculated heat losses and the actual saving as determined by tests. The computed saving tends to be higher than that demonstrated by tests.

Their findings, as reported in a paper by the investigators presented before a recent meeting of American Society of Heating & Ventilating Engineers, were:

For a given type of wall construction, the fuel saving effected by storm windows and doors is dependent on the ratio of the area of the windows and doors to the net area of the walls. The potential saving increases as this ratio becomes greater.

Tightly fitting storm sash practically eliminate the entrance of objectionable amounts of soot.

Storm windows make possible the maintenance of higher indoor relative humidities without condensation appearing on the glass.

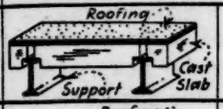
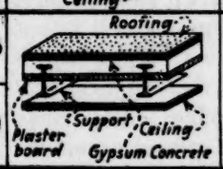
The use of storm windows reduces the draft of cold air down the windows and increases the temperature of the air near the floor of the room.

HEAT TRANSMISSION TABLES

(Values of U for Roofs, Windows, Skylights, and Doors)

FLAT & BUILT-UP ROOFS

Figures for all constructions on this sheet are in B.t.u. per hour per square foot per degree temperature difference, air to air, still air inside, 15 m.p.h. wind outside.

Construct. No.			Thickness of Roof Deck	A	B	C	D	E	F	G	H
					Rigid Insulation				Corkboard		
				No Insulation	½"	1"	1½"	2"	1"	1½"	2"
99		Precast	15/8	0.83	0.37	0.23	0 17	0.14	0.22	0.16	0.13
100		Concrete	2	0.81	0.36	0.23	0.17	0.14	0.22	0.16	0.13
101			4	0.71	0.34	0.22	0.17	0.14	0.21	0.16	0.12
102			6	0.64	0.32	0.21	0.16	0.13	0.20	0.15	0.12
103		Wood	1	0.50	0.28	0.20	0.15	0.12	0.19	0.14	0.11
104			1½	0.37	0.24	0.17	0.14	0.11	0.17	0.13	0.11
105			2	0.32	0.22	0.16	0.13	0.11	0.16	0.12	0.10
106			4	0.18	0.14	0.12	0.10	0.085	0.11	0.094	0.081
107		2" Gypsum Fiber Concrete on ½" Plasterboard	2½	0.38	0.24	0 18	0.14	0.12	0.17	0.13	0.11
108			3½	0.31	0.21	0.16	0.13	0.11	0.15	0.12	0.10
109		Flat Metal	–	094	0.39	0.24	0.18	0 14	0.23	0.16	0 13
110		Precast	15/8	0 42	0 26	0.18	0.14	0.12	0.18	0.14	0.11
111		Concrete	2	042	0.26	0.18	0.14	0.12	0.18	0.14	0.11
112			4	0.39	0.25	0.18	0.14	0.12	0.17	0.14	0 11
113			6	0.37	0.24	0.17	0.14	0.11	0.17	0.13	0.11
114		Wood	1	0.32	0.21	0.16	0.13	0.11	0.15	0.12	0.10
115			1½	0.26	0.23	0.15	0.12	0.10	0.14	0.11	0.095
116			2	0.24	0.21	0.14	0.11	0.097	0.13	0.11	0.091
117			4	0.15	0.12	0.10	0.088	0.078	0.10	0.085	0.074
118		2" Gypsum Fiber Concrete on ½" Plasterboard	2½	0.27	0.19	0.15	0.12	0.10	0.14	0.11	0.096
119			3½	0.23	0.17	0.13	0.11	0.096	0.13	0.11	0.090
120		Flat Metal	–	0.45	0.27	0.19	0.15	0 12	0.18	0.14	0.11

WINDOWS & SKYLIGHTS

121		Single Sash	1.24
122		Double Sash	0.58
123		Triple Sash	0.38
124		Double Glazed Single Sash	0.63
125		Plate Glass 3/8 in Thick	1.19

Double Strength Window Glass 1/8 in Thick

WOOD & METAL DOORS

126		Thin Wood Doors with Glass	1.24
127		1" Wood Doors	0.70
128		2" Wood Doors	0.45
129		3" Wood Doors	0.30
130		Metal and Asbestos Doors	0.65

Published by HEATING & VENTILATING, *148 Lafayette St., New York*

Copyright, 1936, by THE INDUSTRIAL PRESS

HEAT TRANSMISSION TABLES

(Values of U for Roofs, Windows, Skylights, and Doors)

The tables on the other side of this sheet give the values of U of various types of flat and built-up roofs, windows, skylights, and wood and metal doors. U is the amount of heat in B.t.u. passing through 1 sq. ft. of surface in 1 hr. when there is a 1° difference in air temperature between the inside and the outside of the construction. All constructions on the other side of this data sheet are assumed to have still air on the inside and a 15 m.p.h. wind on the outside.

The value of U is for substitution in the following formula to estimate the amount of heat transmitted through any type of construction:

$$H = A\,U\,(t_i - t_o)$$

where H is the total amount of heat in B.t.u. per hour passing through a surface of area A. Temperature of the indoor air is represented by t_i and that of the outdoor air by t_o. Data for the selection of these indoor and outdoor design temperatures are given on H. & V.'s Reference Data 57 and 58.

Values of U have been calculated from the best available data on heat conductivity. These data for a large number of materials have been gathered together and appear on H. & V.'s Reference Data 69 and 70. Persons interested in making their own calculations of values of U for any constructions not included on H. & V.'s Reference Data 71 to 78 will find the method outlined on H. & V.'s Reference Data 69 and 70.

Published by HEATING & VENTILATING, *148 Lafayette St., New York*

Copyright, 1936, by THE INDUSTRIAL PRESS

H. & V.'s REFERENCE DATA—78

Heating a Village from Diesel Exhaust

ONE of the most interesting central heating plants of recent years is that installed at a village settlement in France. This settlement takes the form of a garden city for war veterans suffering from tuberculosis, where the inhabitants live a normal existence and practice their professions in a community which they themselves administer, and where all the services are operated by themselves, the only outside authority being the medical director. The village consists of 180 houses, each with two apartments; a hotel for 200; a central administrative building; a hospital; schools; garage; abattoir; printing plant; laundry, and dyeworks. The entire village is lit and powered by electricity, and centrally heated from a diesel-electric station. The large buildings, hotel, dispensary, hospital, and general stores, all of which have a great demand for heat, are grouped comparatively close together, so that central heating by means of hot water has been adopted.

The interesting point about this installation is, however, that the hot water for heating the larger buildings is supplied from the electric power station, the water being heated by the exhaust gases from the diesel engines driving the generators for supplying the electricity required in the village.

The electric energy required for heating the separate dwelling houses in the coldest weather has been calculated at 1,500 kw., or 36,000 kw-hr. per day. The electric energy required in winter for lighting the village and for the work in the kitchens, etc., varies between a few hundred kilowatts at the minimum to about 2,500 kw. at the times of maximum peak load, with a daily consumption of about 24,000 kw-hr., thus bringing the total electric energy required in winter to 60,000 kw-hr.

In order to generate this quantity of electric energy, seven diesel engines, direct-coupled to alternators each with a normal output of 635 kw. and a maximum peak of 700 kw., have been installed. Dividing the total power among seven units makes it possible to adapt the number of engines in service to the power demanded at the moment, in such a way that the diesel-electric sets are always working as nearly as possible with maximum efficiency, which is about 34%. Each kilowatt-hour is thus produced with the fuel consumption of 0.51 lb. The maximum daily consumption of fuel in winter, for an output of 60,000 kw-hr., is about 30,400 lb.

The three large buildings are heated by hot water which in turn is heated by the exhaust gases from the diesel engines. The cooling water takes about 2660 B.t.u. per hp-hr. from the engine at full load (800 b. hp-hr.); the cooling water consequently takes away 2,140,000 B.t.u. The quantity of cooling water passed through each engine amounts to 20 tons per hour and its temperature is raised 80° in passing through the cylinder jackets. The water is admitted at 83° and leaves at a maximum admissible temperature of 132°. This water, the maximum quantity of which in winter (for 60,000 kw-hr.) is about 2,000 tons per day, then flows into a tank of 45 tons capacity.

The exhaust from the diesel engines is passed through waste heat boilers, one for each engine. These boilers are of the smoke-tube type, with 120 tubes 2.1 to 2.4 in. in diameter and 6¼ ft. long, giving a heating surface of about 430 sq. ft. Each boiler is designed to utilize about 793,000 B.t.u. per hr. from a diesel engine working at full load, and through it 7 tons of water are circulated per hour, entering at 132° and leaving at 185°. This water comes from the 45-ton tank into which the cooling water from the diesel engines flows and is circulated by two electrically-driven pumps, each delivering about 50 tons per hour against a total head of 60 ft. One of these pumps serves as a standby. The water passes through the boilers of the engines which are running and is then led to a storage tank of 500 tons capacity. With the maximum output of 60,000 kw-hr. per day, the quantity of water heated to 185° is 700 tons per day.

In addition, an auxiliary oil-fired boiler, working automatically and capable of giving 1,388,000 B.t.u. per hr., works in parallel with the waste heat boilers, in such a way as to compensate for any discrepancy between the waste heat available and the demand at the moment.

The water at 185° coming from the waste heat boilers or from the auxiliary boiler, and a part of the water at 132° coming from the cylinder jackets of the diesel engines, is utilized directly for heating the three large buildings after it has passed through a mixer to regulate the temperature.

In order to be able to utilize as much of the waste heat as possible, the central heating installation has been designed for a temperature fall of 86°. It requires 58 tons of water per hour, or 1,400 tons per day. This quantity is obtained by mixing 700 tons of water at 132° with 700 tons at 185°. The water utilized has a temperature of 159° when entering the heating plant, and 105° when it returns. When the outside temperature is at the minimum, the total waste heat utilized for the central heating is 158,730,000 B.t.u. per day, i.e., 29% of the local latent heat of the fuel consumed. The efficiency with which the fuel is utilized, consequently, amounts to 34 + 29 = 63%, which is equivalent to the mean efficiency of an ordinary oil-fired boiler in industrial service.

The combination of electric heating and of heating with hot water heated by waste heat consequently gives here the same economy of working as an oil-fired boiler alone, and allows in addition the advantages of using electric heating for the small houses distributed throughout the village.

The heating water at a temperature of 159° is delivered into the pipes of the large buildings by means of four pumps. For work in winter, two pumps are provided, one as a standby, each delivering 55 tons per hour, and for summer work there are two pumps, one also as standby, each delivering 15 tons per hour. The developed length of the longest circuit is about 1,200 yd., the delivery pressure of the pumps is 55 ft.,

and the velocity of flow of the water varies between 200 and 400 f.p.m. Because of this, the pipes can be kept small in diameter and the losses of heat are therefore reduced. The piping leaving the heating station is 4¾ to 5 in. in diameter and is intended for transmitting 6,349,300 B.t.u. per hr. In all, there are about 6,500 yd. of pipes in the installations, about half of which, 3,000 yd., are 0.4 to 0.7 in. in diameter.

The pipes from the heating station to the hotel, and from there to the shops and the dispensary and hospital, are placed in accessible ducts measuring 24 x 20 in. These pipes are isolated by means of cork shells protected by a layer of impermeable cement and bandaged.

The return pipe of the heating system leads to a tank of 20 tons capacity situated in the heating station near the tank of 45 tons containing water at 132°. Any overflow from the 45-ton tank passes into the 20-ton tank, which thus receives about 1,400 tons daily of water returned from the heating system at 105°, and about 600 tons daily of water at 132° which has not been used either in the waste boilers or in the mixing apparatus for the central heating plant. These 2,000 tons of water at 113° are delivered by two sets of automatically starting electrically-driven pumps, one of which serves as standby, into a cooler of the spray type, where the temperature of the water is brought back to a maximum of 83°. The cooler is located about 40 ft. above the level of the engines so that the cooled water can flow under gravity into the cylinder jackets of the engines and from there to the 45-ton tank containing water at 132°. The pressure at the sprayers of the cooler is 23 ft. The pumps delivering water at 113° to the cooler can raise 170 tons per hour against a head of 82 ft. The heat carried away by the cooler is consequently about 131,000,000 B.t.u. per day, or about 24% of the total heat of the fuel consumed.

The remaining 13% of the total heat in the fuel corresponds in part to the heat carried away by the exhaust gases, which leave the waste heat boilers at a temperature of about 302°, and in part to the heat radiated direct from the engines.

The water at 159° is utilized in the buildings not only for heating them, but also for the boilers of the hot water supply plant.

The hot water is produced for the hotel in six heaters, each of 350 gal. capacity, for the hospital in two similar heaters, and for the stores in one heater of 110 gal. capacity. These heaters are fitted with removable heating surfaces.

The general stores are heated with warm air by means of two air heaters which deliver the air into a system of vertical shafts. These shafts serve also to take the water pipes, drain pipes, and electric cables, so that there is no exposed piping, etc., in the buildings.

Birmingham Reports Half of Its Families Use Furnaces

STOVES are used by one-quarter of all the families in Birmingham, Ala., and about the same proportion have central heating plants, according to an analysis on "Consumer Use of Selected Goods and Services, by Income Classes for Birmingham, Ala.," part of a survey being conducted by the Bureau of Foreign and Domestic Commerce. Nearly 72% of the families with less than $500 annual income, and over 56% of all tenant families, report the use of facilities other than stoves or furnaces.

Evidence that owner-occupant families are more inclined to have central heating plants than are tenant families is found in the fact that, while in this city there are nearly twice as many tenants as owner-occupants, the total number of owner-occupant homes with central heating apparatus is almost as great as the number of tenant homes so equipped. The white owner-occupant group exceeds all other racial and tenancy groups in the percentage use of heating plants. Over 40% of these families have some type of central system.

A larger percentage of heating stove users is reported by the group of families with incomes of between $1,000 and $1,500 than by any other one income class. Approximately one-third of these families have heating stoves. Families with incomes of less than $1,000 constitute almost 83% of all reported users of "other" equipment, more than three-fifths of the users of stoves and about 28% of the homes equipped with warm air systems.

That Birmingham users of heating plants show a preference for the warm air system over other types of heating plants is indicated by reported use of that type by about 15% of all families; steam or vapor by approximately 8%, and hot water by less than 3%. Almost half of the families in the three highest income classes use warm air furnaces.

The close relationship between family income and the tendency to use central heating apparatus of some kind is clearly shown by the fact that almost 90% of all families in the two highest income classes own or rent homes equipped with heating plants. Moreover, all successively lower income groups show a steady drop in the percentage of homes supplied with central heat.

This information is given in complete form and numerous tables together with an analysis of the consumer uses of other building goods and services in a publication recently released by the Department of Commerce and devoted to Birmingham, Ala. The author is Ada Lillian Bush, Chief, Consumer Market Section, Marketing Research and Service Division, Department of Commerce, Washington, D. C. Similar analyses have been made for eight other cities—Racine, Wis.; Trenton, N. J.; Salt Lake City, Utah; Fargo, N. Dak.; Austin, Tex.; Columbia, S. C.; Portland, Me., and San Diego, Calif. Cities being studied for future reports are: Burlington, Vt.; Casper, Wyo.; Des Moines, Iowa; Erie, Pa.; Frederick, Md.; Lansing, Mich.; Paducah, Ky.; Portland, Ore., and Oklahoma City, Okla.

EDITORIALS

Degree-Day Competition

It is now over ten years since HEATING & VENTILATING began calling attention to the Degree-Day as a convenient and useful unit for predicting and comparing fuel consumptions. For nearly nine years we have published monthly figures showing the number of Degree-Days in the larger cities.

During this period the Degree-Day has been put to many and varied uses. It has been thoroughly tested out in practice. This we know well because of stories submitted for publication, of stories told us privately and personally, and through correspondence which has grown steadily. We know that the unit has some limitations and some inaccuracies.

Also, we know perfectly well that the full information about the successes and failures which have attended its use has not been made available to readers generally. We would like to do this so all of you may know of the ingenious uses to which this unit has been put. To accomplish this we are conducting a DEGREE-DAY COMPETITION with the offer of generous cash awards. You don't have to be a successful author in order to enter and win one of the awards. We suggest that you turn to page 31 to see the rules of this competition. Then tell us how you have used the Degree-Day in your own work.

•

Radiator Heat and Air Conditioning

Following a long period of disorganization, the several groups most interested in promoting radiator heating have drawn together and organized. The result is the National Bureau of Heating and Air Conditioning with manufacturing trade and installation interests making up its membership. It is announced that one of the purposes is to emphasize the importance of heating in any proposal to secure air conditioning. The initial pamphlet published by the bureau links up the phrases "radiator heating" and "air conditioning."

It might seem at first glance that there is but one item of news in this set of events. In reality there are two. One is the actual accomplishment of some measure of cooperation to permit a promotional organization. The other is the adoption of a slogan which really ties radiator heating up with air conditioning. Both moves are distinctly innovations.

That these groups have needed a more closely knit organization has been evident for some years. Neither is there any doubt that they have suffered from lack of a strong central body equipped to do a promotional job. This has been especially noticeable by comparison with the promotional achievements of other groups.

Differences of opinion and lack of cooperation are also probably responsible for the failure of these groups to seize upon the growing popularity of the words "air conditioning" for so long a period. While others were out capitalizing them to the limit—or even beyond the limit—there was a strange paralysis on the part of the radiator heating groups. They seemed to prefer to see business slip away from them rather than to vehemently declare that they were able and willing to furnish air conditioning to all comers. So the appearance of the two linked together comes as a logical, if belated, move.

At that it may not be so belated. Neither in the long run need it necessarily prove true that there has been any loss of business or prestige to these groups. Their delay has no doubt permitted them to miss at least some of the headaches which some of the earlier enthusiasts on air conditioning encountered.

With the new set-up radiator heating is now in a better position to go places competitively than for some time. It remains now to be seen how effective the new organization turns out to be.

Radiator heating with a separate means of moving air or of heating, cooling, or moistening it has some technical advantages. Indeed there is a strong likelihood that some form of "split" system is likely to prove increasingly popular. There is a real challenge to brains and ability in this situation. The battle to see who is going to fall heir to the legacy of popular interest in the words "air conditioning" is by no means over. Let no one be misled into supposing that any one method or any one commercial group has yet succeeded to the title. Instead the opposing forces are really just going through their training periods, getting their tactics straightened out, their lines of supply established, and in general doing what any well organized army has to do before the field operations, including the casualties and the glorious victories, really start.

•

Public Works for Relief

Federal money for work relief for at least another year is a certainty. The administration asks for a billion and a half for this purpose to be spent largely at the discretion of the Executive. The bill to put this plan into effect is pending and carries the all-powerful support of the president.

Presumably it will pass and the money will be largely spent by the method of made-work and a certain amount of building construction as well as by the continuation of CCC.

In this set-up there appears to be little place for the organization and the method of expenditure developed by the Public Works Administration. This organization after a slow start and much preliminary work has reached a position where it is able to handle the loan-and-grant method of expenditure to advantage. The loan-and-grant method likewise is ready for the discard if the administration plan carries through. So too will about one and a half billion dollars of projects already examined and approved by PWA be without funds to proceed.

Recently a movement has been started to insure continuance of PWA and those approved projects by designating that a considerable fraction—$700,000,000 out of the billion and half—of the proposed funds be diverted to PWA. Presumably a considerable part of the $700,000,000 would go to building construction and all of it would go to projects of permanent nature instead of to work of maintenance character.

This movement has drawn substantial support. It has the active backing of the Construction League and its member organizations. A considerable number of congressmen have signed a petition requesting administration support for the revised plan. Hopes are not high that this will be forthcoming, however.

Things are now in the stage where a letter or telegram to your senators and representatives may do some good. The proposal is generally known as the Hayden-Beiter Public Works Bill. If you believe with the Construction League that the PWA organization and method should be continued instead of virtually passing out of the picture this fall let your representatives know where you stand now.

ABSTRACTS of Current Papers, Books and Pamphlets

Graphical Solutions

Prof. Charles O. Mackey, of Cornell University, whose name is familiar to many readers of HEATING & VENTILATING as the author of a series of articles describing and discussing the various types of psychrometric charts, is the author of a new book on graphical solutions. The purpose of the book is to show the engineer how to make graphical or mechanical representations of equations and how to fit equations to experimental data. Alignment charts, network charts, sliding scales, and other graphical solutions are completely described. The book, while not a treatise on graphical computations, contains sufficient material for a well-rounded course on the subject. The treatment is fairly elementary and most of the examples can be worked out with a slight knowledge of logarithms, algebra, and plain geometry.

Included in the book is a logarithmic scale for making up charts to various logarithmic scales. Illustrations in the book are half size of the original drawings so that students having trouble with problems can check quite easily.

[*"Graphical Solutions," by Charles O. Mackey, M.E., Assistant Professor of Heat Power Engineering, Cornell University. Published by John Wiley & Sons, Inc., New York. Cloth-bound; 6 x 9 in.; 130 pages; price, $2.50.*]

•

Church Property and its Management

Although this book was written primarily as a manual of management for the parish priest, it should prove of considerable value to contractors and engineers dealing with priests and other managers of religious properties. It should give the contractor an insight to the problems, laws, and traditions which the manager and builder of Catholic religious properties must face.

The author of the book is an authority in the field of industrial management and has had considerable contact with men managing church property. The book grew out of a series of lectures given before men studying for the priesthood.

The book is divided into six main sections, each dealing with a different aspect of the management problem. The six sections are entitled as follows: principles, personnel phase, financial phase, legal phase, social and ethical phase, and technical phase. Some 15 pages of the technical section are devoted to air conditioning, about 15 to ventilation, and about 36 to heating. While the method of treatment is rather elementary, it is well done and should prove of considerable help to the non-technical man desiring to learn something of these subjects.

[*"Church Property and Its Management," by H. A. Frommelt; published by The Bruce Publishing Co., 524 N. Milwaukee St., Milwaukee, Wis. Cloth binding; 6 x 9 in.; 381 pages; price, $3.*]

•

Crushing of Coal in Small Bituminous Stokers

In practically all stokers there is some crushing of the coal by the worm screw which carries the coal from the hopper to the retort. Just how much breaking down does occur and what it depends upon are not definitely known. This was the first major problem that the Bituminous Coal Research, Inc., encountered in its investigation of the effect of size of coal on the performance of stokers.

Four typical coals were obtained for the tests. The relation of the size of the coal put into the hopper to that delivered to the retort was studied for a number of different sizes of each coal by making screening analyses before and after putting the coal through the stoker. Two of the coals were treated with oil, as is common practice to render the coal dustless, and the effect of the treatment on the crushing determined.

The more important findings can be summed up as follows: 1—The percentage reduction in the size of coal is definitely related to the hardness of the coal as expressed by the friability index. 2—The larger sizes, over 1 in. or ¾ in., so largely disappear in the coal that reaches the retort that it is not expected that the small amount remaining will materially affect the combustion of the coal. 3—An appreciable amount of fine sizes of coal, 39% of the sizes below ⅜ in. with the hardest coal and 65% with the softest coal, was formed, although none was in the coal placed in the hopper. 4—Oil treatment did not affect the reduction in the size of the coal but it did decrease the segregation both in the hopper and in the retort.

The immediate practical significance of these conclusions is that the top size of the coal for small stokers need not be greater than ¾ in., or at the most 1 in. The elimination of the larger sizes, which can be retained by the producer for his nut sizes, will not only reduce the work spent in crushing in the stoker but will also decrease the difficulty with segregation of the large and small coal each time that it is handled between the loading at the mine and delivery to the consumer's bin.

[*"The Relation of the Size of Bituminous Coals to their Performance on Small Underfeed Stokers, Part 1," by R. A. Sherman and E. R. Kaiser. Published by Bituminous Coal Research, Inc., 803 Southern Building, Washington, D. C. Paper bound; 6 x 9 in.; 27 pages; price, 25c.*]

•

BRIEF REVIEWS

AIR HYGIENE FOUNDATION. A bulletin on the purposes and regulations of the Air Hygiene Foundation of America, Inc., which was formed to conduct investigations and to stimulate research on problems in the field of air hygiene as well as to gather and disseminate factual information relating thereto. [*"Purposes and Regulations," Information Circular No. 1, Air Hygiene Foundation of America, Inc., Pittsburgh, Pa. Paper bound; 3 3/4 x 9 in.; 12 pages; available on request.*]

GAS HEATING EQUIPMENT. The purpose of this paper is to act as a guide to successful installation and maintenance practice in gas fired, central heating. [*"Installation and Maintenance Practices of Central Heating Equipment," Interim Bulletin No. 18, Commercial Section of the American Gas Association, 420 Lexington Ave., New York. Paper cover; 3¾ x 8½; 19 pages. Price, 20c. to non-members.*]

STANDARDS. This is a complete listing of all of the standards and safety codes issued by the American Standards Association up to March 1, 1936. [*"A Manual of American Standards Approved by the American Standards Association." Published by the American Standards Association, 29 West 39 St., New York. Paper Cover; 7½ x 10½ in.; 12 pages.*]

NEWS OF THE MONTH

Tentative ASHVE Program Announced

NEW YORK—The summer meeting of the ASHVE will be a joint one with the ASRE, with ASHVE headquarters at The Inn, Buck Hill Falls, Pa., and the ASRE making its headquarters at Skytop Club, Skytop, Pa., several miles away. Both meetings are from June 22-24. A joint session will be held on the second day, June 23.

All of the technical meetings of the ASHVE will be held at 9:30 in the morning, leaving the afternoons free for recreation and social activities. The tentative technical program of the ASHVE follows:

MONDAY, JUNE 22

Corrosion Studies in Steam Heating Systems, by R. R. Seeber, F. A. Rohrman, and G. E. Smedberg.

Performance of Underfeed Domestic Stokers Burning Bituminous Coal, by T. G. Estep.

Relative Absorption of the Various Sections of a Round Heating Boiler, by A. J. Johnson.

TUESDAY, JUNE 23

Theory and Practice of the Heat Pump, by C. W. Chamberlain.

Application Factors Which Govern the Selection of Freon Refrigerating Equipment for Air Conditioning Service, by J. R. Hertzler.

Water Supply as Affected by the Demand for Summer Air Conditioning, by D. C. Morrow.

WEDNESDAY, JUNE 24

Development of Testing Apparatus for Thermostats, by D. D. Wile.

Pyrheliometers and the Measurement of Total Solar Radiation, by L. A. Harding.

Field Tests to Determine the Heat Requirements of Buildings, by F. E. Giesecke.

Heat Requirements of the Grant Building, by F. C. Houghten.

Power Show Set for December

NEW YORK—The management of the National Exposition of Power and Mechanical Engineering has announced that the 12th exposition will be held from November 30 to December 5, inclusive, coincidental with the annual meeting of the ASME. Over a hundred former exhibitors have reserved space and applications.

The advisory committee of the Exposition includes: L. E Moultrop, chairman, Homer Addams, W. L. Batt, N. A. Carle, Fred Felderman, C. F. Hirshfeld, O. P. Hood, G. L. Larsen, John H. Lawrence, L. S. Morse, D. M. Myers, and Charles F. Roth.

DEGREE-DAY COMPETITION ANNOUNCED

HEATING & VENTILATING announces in this issue its DEGREE-DAY COMPETITION with $160 in prizes for the best articles dealing with the Degree-Day and its use. Further details on page 31.

Warm Air Meeting Scheduled

COLUMBUS, OHIO—The mid-year meeting of the National Warm Air Heating and Air Conditioning Association will be held June 17-18 at the Deshler-Wallick Hotel here, according to A. W. Williams, managing director of the association. Advance notices indicate that among the subjects to be discussed are forced air in its various phases, selling, profitable air conditioning, including a resume of the research work in that subject, controls, and oil burning furnaces.

A new feature at this particular meeting will be a special noon luncheon to be served in the Deshler-Wallick Hotel's Hall of Mirrors, immediately following adjournment of the Wednesday morning, June 17, convention session.

The afternoon of Thursday, June 18, is to be occupied by a golf tournament with prizes. This will be open to all.

Employment Up, Moyer Finds

BOSTON — Better employment prospects in the air conditioning industry are reflected by enrollment gains in study courses offered by Massachusetts University Extension, it is announced at the State House here by Director James A. Moyer.

Twenty-two states, from Florida to California, are represented by men now taking the correspondence course in air conditioning, and class instruction in Massachusetts topped last year's figures. More than 1,200 adult students have enrolled in this new subject to date.

A varied list of trades and occupations is represented by those taking courses: clerks, salesmen, mechanical and power sales engineers, sheet metal workers, master plumbers, laborers, chauffeurs, steamfitters, auto mechanics, electricians, a hotel manager, inspectors, school teachers, carpenters, radio technician, and masons.

Changes in FHA Regulations

WASHINGTON—Five important changes in the regulations of the modernization credit plan have been made necessary by the passage of the amendment extending Section 2 of Title I of the National Housing Act to April 1, 1937. The first change is the elimination of all new construction on unimproved real property from consideration under the plan, and the exclusion of loans to tenants except those who are lessees.

The second change makes portable equipment ineligible. The Act specifically excludes from insurance loans or advances of credit in the amount of $2,000 or less for the purchase and installation of equipment or machinery upon any type of improved real property. However, the bill does permit the insurance of loans or advances of credit for the purpose of making additions to real property. Therefore, items of machinery and equipment which become additions to the real property will be considered eligible, whereas those which do not become additions to the real property (i.e., a part of the structure) will be considered as ineligible. Under this interpretation heating, plumbing and wiring systems, including such items as furnaces, oil burners, stokers, water heaters, etc., would be eligible for financing. However, movable equipment such as refrigerators, ranges, washing machines, ironers, etc., would not be eligible.

The third change is that after March 31, 1936, the insurance against loss to the lending agencies is reduced from 20% to 10% of the total amount of the loans made or credit advanced.

The fourth change is the reduction of the maximum liability which the Federal Housing Administrator may incur for modernization credit insurance; it was reduced from $200 million to $100 million. The fifth change is that churches have been placed in Class A and can borrow up to $50,000 instead of only up to $2,000 as before.

Boston A.C. Bureau Exhibits at Conference

BOSTON—In lieu of the regular monthly meeting and dinner, the Air Conditioning Bureau of Boston took part in the program of the New England Building Officials Conference at the Hotel Statler, April 20-22. The Bureau had a booth in which were exhibited photos and drawings of various air conditioning installations.

Subjects discussed at the sessions included a paper on "Air Conditioning and Its Relation to Public Health," by Prof. Philip Drinker, associate professor, Harvard School of Public Health.

NEWS OF THE MONTH

Bypass Patents Decree Upheld

NEW YORK—The U. S. Circuit Court of Appeals here has upheld the decision of the U. S. District Court in the case of Auditorium Conditioning Corp. vs. Warner Brothers Pictures, Inc., invalidating the air conditioning bypass patents owned by Auditorium.

Judge Coxe of the Distict Court, during 1935, had ruled that certain claims of the Lewis and Fleisher patents were invalid for lack of invention. The more recent decree upholds Judge Coxe's decision.

Iron Fireman Opens Sales Campaign

CLEVELAND—With a new product, the Coal Flow, the Iron Fireman Manufacturing Co. is launching an aggressive sales and advertising program, details of which were announced at the March convention of the company's sales force here.

The 1936 advertising program will have twice as many individual messages as in any previous year. A campaign in 39 leading metropolitan Sunday newspapers will use advertisements large enough to dominate a newspaper page and will apear throughout the selling season. In addition to this, Iron Fireman will conduct a campaign in 28 leading magazines and trade publications.

The Coal Flow is a residential bin-feed machine that eliminates manual handling of fuel. A long worm conveys coal automatically from bin to fire. The worm can be placed either above or below the basement floor.

Speakers on the program included T. H. Banfield, president; E. C. Sammons, vice-president; C. T. Burg, general sales manager, and Joseph R. Gerber, president of Gerber & Crossley, advertising agency.

New Thermostat Company

BRIDGEPORT, CONN. — The Bridgeport Thermostat Co., a newly organized Delaware corporation, has taken over the thermostat and bellows division of Bridgeport Brass Co. and will start independent operations in June in a factory building at Connecticut Ave. and Florence St. which has just been acquired. The new company will manufacture thermostats, hot water heaters, and temperature controls formerly made by the brass company.

William F. Macdonald is in charge of engineering operations for the thermostat company and W. J. Van Harten is assistant treasurer and presumably will have general charge of the factory. Other offices and executives have not been identified. Operations will start with about 500 hands, most of them transferred from the brass company payroll, and more will be added in September, it is understood.

Centralize Heating Plants

NEW BRITAIN, CONN.—Centralization of heating plants for city-owned buildings has been started by the municipality with WPA funds, two separate plants having been approved as federal projects. One plant is being installed in the cellar of the fire department headquarters building on Commercial Street to heat that structure as well as police headquarters and the municipal garage.

The second central plant will displace three separate plants now used to heat the New Britain Town Farm. John Leonard, heating engineer in charge of the city's work, has proposed installation of an oil-fired boiler in a pit beneath a small cupola outside the farm buildings, with a covered stairway leading to the controls. This plan would lower insurance costs and release needed space in the buildings.

Milwaukee Plans A.C. Show

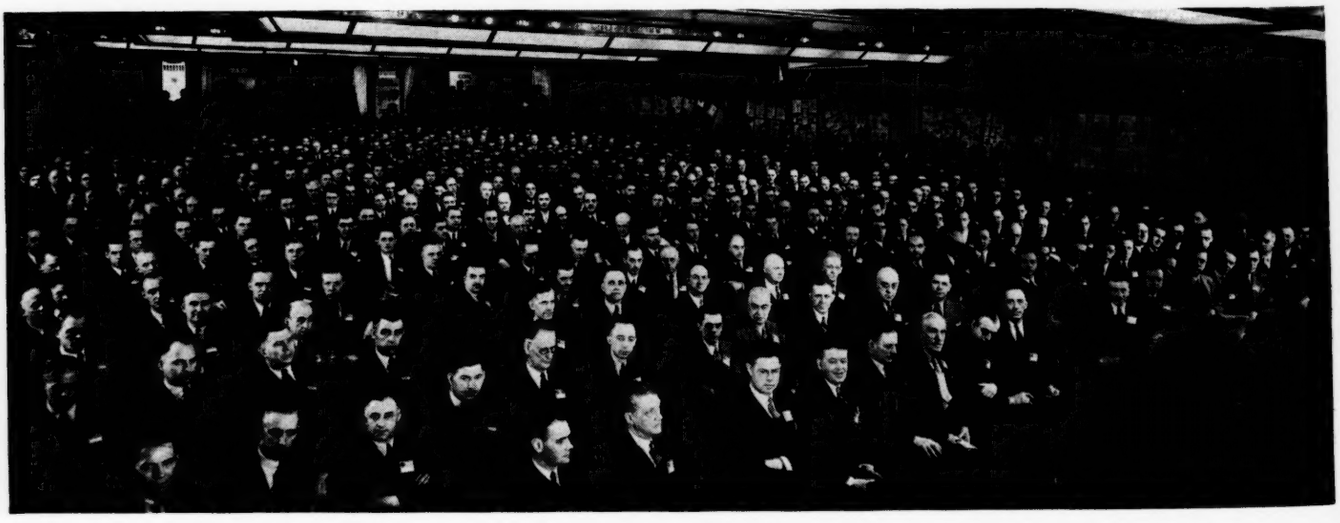
MILWAUKEE—Based on the results of a survey made among contractors, distributors, and dealers of air conditioning and heating equipment, plans have been formulated for the 1st Wisconsin Air Conditioning and Heating Exposition to be held in the Auditorium here May 12-16.

As a result of the support and opinions expressed by Milwaukee and Wisconsin leaders in the interested industries and trades the exposition is to have a dual purpose. First, it is to serve as a means of needed educational work as to present day air conditioning and heating. Second, by appealing only to present building owners planning on remodelling or, those who contemplate building, contractors and dealers participating in the show will be put in contact with prospects.

The Master Sheet Metal, Heating and Air Conditioning Contractors Association and the Milwaukee Association of Heating, Piping and Air Conditioning Contractors have indicated their intention to support and exhibit in the exposition. Milwaukee members of the ASHVE Wisconsin Chapter also see in this proposed exposition an excellent opportunity to give added impetus to the industry.

A. C. for Central of Georgia

BIRMINGHAM—All sleeping cars operated on the Central of Georgia Railway will be air conditioned during the coming summer, according to H. D. Pollard, receiver. In addition, air conditioned coaches will be operated on the main lines, and the Central's four through trains from the North and West to Alabama, Georgia, and Florida will be completely air conditioned throughout. These four trains are The Seminole, Dixie Flyer, The Southland, and Flamingo-Dixie Limited.



Main session of Iron Fireman Manufacturing Company international sales convention, Cleveland, March 16-19.

Outlines PWA Work in Illinois

CHICAGO—Contracts on PWA jobs for heating and ventilating systems have amounted to approximately $3,500,000 in direct awards, Carl H. Bauer, state director for Illinois of PWA, told the Illinois Chapter, ASHVE, April 13 at its meeting in the Hotel Sherman.

Listing some of the larger heating and ventilating jobs, Mr. Bauer cited the PWA program sponsored by the state, which is using $931,000 in various hospitals and other buildings now under construction; a $135,000 contract for the University of Illinois medical laboratory in Chicago; $142,000 for the Peoria Schools, and $172,000 for the Cook County Nurses' Home. The great majority of the contracts were in smaller projects.

The PWA program has resulted in a large increase in employment, not only in direct labor on the projects, but in the industries which supply materials needed for the heavy construction projects sponsored by the Public Works Administration, Mr. Bauer said. More than a billion dollars of PWA improvements have been completed and are in use in the country, while in Illinois, 153 projects have been completed at a total cost of $28,300,000, and 262 projects are under construction, with a value of $123,000,000.

Gas Heating Up in Seattle

SEATTLE — Large gains in the gas heating of homes in Seattle, as well as more extensive use of gas for commercial and industrial purposes were revealed with the filing of the first quarter report of the Seattle Gas Company. James F. Pollard, president and general manager of the utility, pointed out that in March of this year Seattle had 420 more gas heated homes than in March, 1935, an increase of 30%. Sales of gas for commercial and industrial purposes are up 9%. An average rate reduction of about 12% was made by the gas company last fall.

A.C. for Canadian Roads

OTTAWA, ONT.—One of the features of the Dominion Government's program being evolved for the relief of unemployment may likely be the air conditioning of the more important train services on the Canadian National Railways.

Competition from the United States railways with air conditioned cars is being felt in Canada. Travelers going part of the way on the trains across the border find it irksome to change to the hot coaches in Canada. Owing to the railways in Canada lacking necessary finances for such equipment it is likely the government may assist them in the matter.

Campaign Explained to Supply Men

CHICAGO—The movement to popularize radiator heat with air conditioning was presented before the 487 members who attended closing session of the Central Supply Association held here April 22-23. W. J. Spillane, past CSA president, and L. J. De Neille, HPACCNA president, traced the beginnings of the plan, told of its progress, and discussed plans for the immediate future.

Premier showing of a movie setting forth the advantages of radiator heat with air conditioning was given before the assembly which was composed of the supply men. Mr. Spillane described and pointed out the various features of the film.

In summing up the plans for the drive, which is now being put on here locally by the National Bureau of Heating and Air Conditioning, Mr. De Neille said that two new booklets, both fully explanatory of the movement and containing question and answers, one for architects and engineers and the other for homeowners, would be off the press shortly. In closing, he said that the drive would go forward rapidly during the next few months, and urged the full support of all members of the industry.

Chicago Burner Men Elect

CHICAGO—A new plan of representation for different branches of the industry was placed into effect at the 15th annual meeting and election of officers of the Chicago Oil Burner Association, held in its headquarters here April 23. The membership was classified into four divisions and a member representing each was elected to serve as vice-president of the association. This move was made both to insure equal voice to all branches of the industry and to allow individual groups to meet separately headed by an association officer. The divisions are: domestic burners; industrial burners; oil dealers selling burners, and accessories.

J. W. Manny, Davies Supply Co., was elected president. Vice-presidents representing the four divisions are: W. F. Meagher, A.B.C. Oil Burner Co., representing the domestic burner group; E. W. Mautner, Mid-West Heat Service, representing the industrial burner group; D. S. Whammond, Arrow Oil Burner Co., representing the oil dealers, and A. F. Krumholtz, representing the accessories group.

The newly-elected board of directors consists of D. C. Malone, Petroleum Heat & Power Co.; H. G. Shaffer, Enterprise Oil Burner Co.; W. A. Matheson, Williams Oil-O-Matic Heating Corp.; D. K. Moor, Timken Silent Automatic Co., and R. Hamlin Petty, executive secretary.

Coal Short Course at U. of Ill.

URBANA, ILL. — The third University of Illinois short course on coal utilization will be held on the campus June 9-11, according to Prof. A. C. Callen, head of the department of mining and metallurgical engineering which sponsors the meeting.

The purpose of the conference is to present technical and practical information pertaining to coal and its efficient utilization for the benefit of those engaged in mining, preparing, marketing, and using coal, as well as those manufacturing and distributing machinery for the preparation and utilization of coal.

Glass House for Woman Executive

LYNN, MASS. — Mrs. Aroline Gove, head of the Pinkham Medicine Company of this city, is having plans drawn for the first livable glass house in the United States. Her first plan was to build a glass apartment house in Swampscott, but the town's zoning laws conflicted, so she has modified her plan to build a single family house of translucent glass blocks. Her architect, who designed her a palatial home modeled after a French chateau, in Marblehead, known as "Carassone," is designing a house that will cost between $20,000 and $30,000 and have hollow glass block partitions, as well as glass block outside walls. There will be five bedrooms, three baths, living room, library, dining room, kitchen and service rooms. Plans for heating, air conditioning and ventilation have yet to be developed.

Utility Sets Up Commercial Bureau

BOSTON—Commercial activities of the Boston Edison Electric Illuminating Co., including underground steam service sales and electric current sales, together with promotion and appliance activities, have been combined in one organization through the establishment of the Commercial Bureau. Louis R. Wallis is head of the bureau, and Julius Daniels, president of the Air Conditioning Bureau of Boston and previously sales promotion manager for the Boston Edison, is assistant bureau chief.

Smith Heads Chapter

PHILADELPHIA — The Philadelphia chapter, ASHVE, held its annual meeting at the Engineers Club, April 9. William R. Smith, Wm. Anderson Co., was elected president for the coming year. Other officers elected were: Lee P. Hynes, Hynes Electric Heating Co., vice-president; R. F. Hunger, Davidson & Hunger, treasurer, and H. H. Erickson, General Fittings Co., secretary.

NEW EQUIPMENT

Arco Conditioner

NAME AND MODEL NUMBER—Air conditioners, models 101-B and 201-B.

PURPOSE—An indirect conditioner for use with radiator heating systems. Supplies humidification, circulation, cleaning, and ventilation. Cooling and dehumidification can be added if desired.

FEATURES—A self-cleaning nozzle with integral strainer is used in spray type humidifier to provide moisture. Water from the nozzle is played upon a plate glass target, which can be adjusted to vary the quantity of water taken up by the air. For air cleansing, a replaceable type filter, constructed of corrugated fiber board and arranged to form V-shaped cellular passages, coated with a tacky compound, is used. A centrifugal type blower with special mountings and acoustically lined air outlet, designed to absorb vibration an reduce noise, is used to circulate the conditioned air throughout the house. Outside air, taken in for ventilation, is passed through a tempering coil that warms the air to room temperature and at the same time takes out entrained moisture.

Ordinarily, the conditioner is placed on the ceiling of the basement and only a minimum of standardized air ducts is used to deliver and return the air. Conditioner is cased in steel casing finished in standard green.

SIZES AND CAPACITIES—Model 101-B is suitable for houses up to 12,500 cu. ft.: model 201-B will provide from 12,500 to 25,000 cu. ft.

MADE BY—*American Radiator Corp., 40 W. 40 St., New York.*

Miller Conditionair

NAME—Miller Conditionair.

FEATURES—A room unit for heating, cooling, cleaning, humidifying, and perfuming or medicating the air, if desired. Unit contains a motor-driven fan which forces the air through the filter and over the extended heating and cooling surfaces. Heating is by a hot water supply line from the water heater. Cooling is by water or direct expansion. Cabinets of furniture steel.

SIZES AND CAPACITIES—550 c.f.m.

MADE BY—*Miller Conditionair, Inc., 1138 South Broadway, Los Angeles, Calif.*

Ideal Packless Convector Valve

NAME AND MODEL NUMBER—Ideal convector packless gate valve No. 475.

FEATURES—Includes all features of the former No. 375 valve and adds packless feature. Especially intended for valves located within enclosures where repacking is difficult. Intended for convector type radiators where only a limited amount of space is available.

SIZES AND CAPACITIES—In ½ in., ¾ in., 1 in., and 1¼ in. sizes.

MADE BY—*American Radiator Corp., 40 W. 40 St. New York.*

Sponge Rubber Insulation

NAME—Sponge rubber insulation.

PURPOSE—Heat insulation, especially for cold lines in air conditioning and refrigeration.

FEATURES—In addition to being porous, sponge rubber is flexible and can be molded into nearly every conceivable shape. It is available in tubing which can be used to cover pipe lines when straight, curved or coiled by slipping it over the pipe, thus making possible quick assembling of insulation for the line. Available also in flat slabs and in molded fittings to conform to many peculiarly shaped valves and joints. Material has a skin which covers the outer surface and the thin walls separating the individual cells and tends to prevent moisture absorption.

SIZES AND CAPACITIES—Available in several densities. The coefficient in B.t.u. per hour per square foot per degree difference per inch of thickness is 0.64 for 0.27 oz. per cu. in. density; 0.69 for 0.28 density, and 0.72 for 0.285 density. Tubing available with inside diameter ranging from ¼ in. to ¾ in., and with outside diameters ranging from ¾ in. to 1¼ in., and in lengths from 22 in. to 46 in. Flat slabs are available in various

colors including black, yellow, and red, and in a number of different sized sheets and in thicknesses ranging from approximately ⅛ in. to 1 in.

MADE BY—*Miller Rubber Co., Inc., 1247 S. High St., Akron, Ohio.*

Emerson Seabreeze Exhaust Fan

NAME—Seabreeze ventilating fans.

PURPOSE—Air exhaust.

FEATURES—Induction type motor, self-aligning wool-packed bronze bearings with felt-packed oil reservoirs. Adjustable panel for windows or transoms said to be easy to install and not to interfere with operation of window. Wall box, adjustable to wall thickness, may be installed in homes under construction, or already completed, and has an automatic door-jamb starting and stopping switch. A handle for convenient operation of the door furnished. Panel and wall box are finished in washable grey finish.

MADE BY—*Emerson Electric Mfg. Co., St. Louis, Mo.*

Penn Automatic Day-Nite Control

NAME AND MODEL NUMBER—Penn types 770 Tem Clock and 860 Day-Nite Imperial Temtrol.

PURPOSE — Electric switch clocks for full automatic control of set-back temperature.

FEATURES—Tem Clock operates on 25 volts and controls set-back temperatures, day or night, as desired, through low voltage electrical connection to the Temtrol. This permits the former to be mounted on the wall at eye level, with the Temtrol mounted in the 4-ft. zone. Both the time for automatic starting of periods of set-back temperature and the time for ending of such periods may be set easily. A knob built into the front cover of the clock indicates whether high or low temperature is being maintained. When manually set for high temperature, the clock will automatically begin timed day-nite control at the beginning of the next low temperature period for which it is set; when manually set for low temperature, the clock will return to fully automatic control at the beginning of the next high temperature period. Set-back temperatures are obtained by action of a small resistance heater, built into the Temtrol through a low voltage circuit closed by the switching mechanism of the clock. Set-back of night temperatures is obtained through electrical action.

MADE BY — *Penn Electric Switch Co., Des Moines, Iowa.*

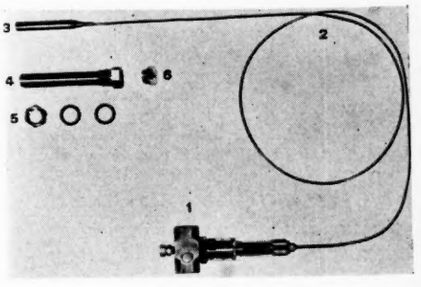
Yarway Steam Controlled Valve

NAME—Yarway automatic steam control valve.

PURPOSE—For connection to the outlet or condensate end of steam heating coils in water heaters and in various types of industrial process equipment in which close regulation of temperature is required. When so connected, this valve is said to eliminate use of steam regulators and steam traps and frequently with pressure reducing valves.

Valve (1) is of throttling type, operated by thermostatic element (2) of bulb and bellows design. Temperature adjusting sleeve covering bellows end of thermostat is screwed in for lower temperatures, out for higher temperatures. Choke screw on end of valve is adjusted to suit normal condensate flow. Plug on side permits check on operation. After initial adjustments for temperature and flow are made, the control is automatic in action, opening to discharge condensate when temperature of liquid falls a few degrees below point desired and closing when sufficient steam has been admitted to heating coil to re-establish operating temperature.

Thermostat bulb (3) may be clamped to outside of heater shell but is usually inserted



in sleeve (4) which projects into water space in tank. The sleeve is screwed into ½ in. connection on tank wall or fastened in place by lock nut and lead washers (5). Bulb is locked into sleeve by split nut (6).

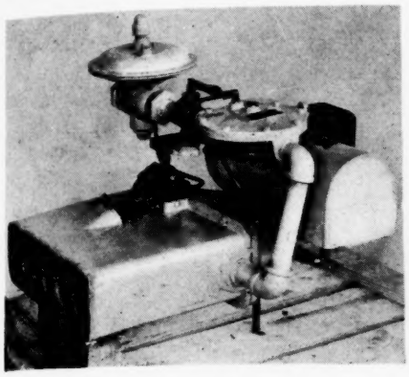
MADE BY—*Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.*

Lo-Blast Gas Conversion Burner

NAME—Lo-Blast gas conversion burner.

PURPOSE—Applications to down-draft or revertible flue type boilers or furnaces.

FEATURES—Of cast iron construction.



Working parts outside of the furnace. Said to have no intricate refractories. Has gas-actuated control valve. Burner and pilot safety element are protected from reflected heat. Slow speed motor is resiliently mounted, and air is delivered at low pressures so that unit is said to operate silently. Electrical consumption 47 watts.

SIZES AND CAPACITIES—A range of sizes with capacities from 100,000 to 4,500,000 B.t.u. per hr.

MADE BY—*National Machine Works, Peoples Gas Bldg., Chicago.*

Lewis Mechanical Warm Air Conditioner

NAME—Lewis mechanical warm air conditioner.

PURPOSE—Winter air conditioning; can be used for summer conditioning if electrical refrigeration or water cooling is supplied.

FEATURES—Air is preheated before being filtered and humidified and then passed over the combustion chamber. Designed to operate with oil or gas burner. Humidifies, filters, and circulates the air. Occupies 23 sq. ft. of floor space. Housed in furniture steel with aluminum trim.

SIZES AND CAPACITIES—Available in four models with capacities ranging from 120,000 to 225,000 B.t.u. per hr. at the bonnet.

MADE BY—*Lewis Air Conditioners, Inc., 1600 Northeast Broadway, Minneapolis, Minn.*

Pliers for Copper Tubing Joints

NAME—Thermo-Grip pliers.

PURPOSE—An electric tool for making sweated joints in solder type copper pipes and tubing.

METHOD OF OPERATION—To make a joint, clean pipe, tube, or fitting thoroughly in regular way, apply flux, slip fitting over end of pipe and clamp jaws of the pliers lightly on the outside of fitting, exactly where heat is required. The joint will come up to temperature rapidly, allowing solder to be spread between pipe and fitting to complete joint.

FEATURES—Unit easily portable, weighs 14 lb. Pliers have renewable carbon jaws, insulated fiber handles. Cord connection is 10 ft. long, and two 6-ft. lengths of heavy duty cable connect the transformer and pliers.

MADE BY—*Ideal Commutator Dresser Co., 1536 Park Ave., Sycamore, Ill.*

Inco Sheet Metal Deadner

NAME AND MODEL NUMBER—Inco No. 513 Sheet Metal Deadner.

PURPOSE—A flexible insulation and sound deadening material for insulation against sound and heat.

FEATURES—Material is applied by either trowel or spray gun, and sets up in from three to five minutes. Is said not to sag or run when applied ¼ in. thick on a vertical surface. Has sufficient thermal insulating value to prevent condensation under ordinary conditions. Provides waterproof coating for either inside or outside work and is said to be sufficiently pliable to guard against cracks yet hard enough that it will not become sticky or tacky. Its adhesive qualities enable it to make a seal for leaks and joints in ductwork. Where it is necessary to use cork insulation this material can be used as a seam filler. Is an insulator and non-conductor of electricity; rodent and verminproof.

MADE BY—*Inter-Coastal Paint Corp., 13 St. and Southern Railway, East St. Louis, Ill.*

Sound Level Indicator

NAME AND MODEL NUMBER—Model 300 sound level indicator.

PURPOSE—To measure sound levels as heard by human ear.

FEATURES—Consists of a calibrated crystal type microphone, an audio-frequency amplifier with the all metal tubes, calibrated attenuator, ear weighing network, decibel meter and crystal type headset. The range is from 30 to 90 decibels, A.S.A. standard. Although designed for a.c. operation, batteries may be used.

MADE BY—*Industrial Apparatus Co., 720 N. Wabash Ave., Chicago.*

Troxell Dual Fan Ventilating System

NAME—Dual fan ventilating system.

FEATURES—Outside air is drawn in, filtered, and delivered in ducts to disseminating points. At these points, the dual fans, powered by fractional horsepower motors in each unit, pull the air through the duct, release fresh air at the unit location, mix it with room air. The fresh air is diffused horizontally in all directions, near the ceiling, and sinks downward in a draftless flow. Motors are concealed in the duct and plug into lighting circuit. Unit is readily accessible, can be taken down without tools for inspection and oiling. Automatic dampers keep each unit working while other units on the same duct may be shut off. A main damper can control the fresh air intake or stop it altogether.

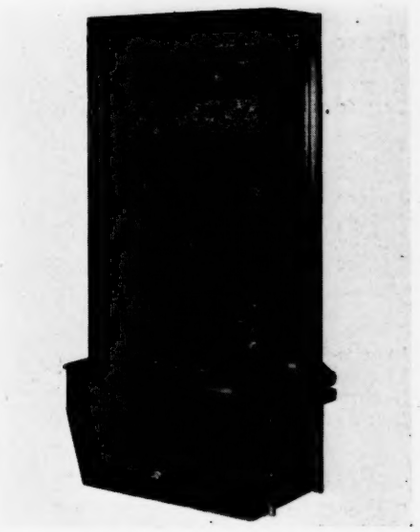
SIZES AND CAPACITIES—Fans are available in six different models with capacities ranging from 100 to 425 c.f.m. each.

MADE BY—*E. R. Troxell, Jr., Bronxville, N. Y.*

Staynew Filter

NAME AND MODEL NUMBER—Staynew automatic air filter, model A.

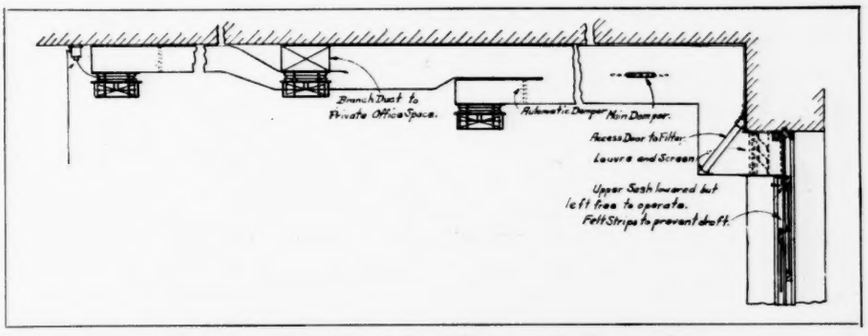
FEATURES—Provides four successive stages of filtration, in form of two endless curtains, arranged to rotate in such a manner that the face of the curtain, on the dirty air side, will be thoroughly cleaned before returning to the clean air side. The first stage collects the heavier part of the dust, serves to break up the air flow into small streams, causing it to assume more intimate contacts with the adhesive surface. It then proceeds downward into the oil bath, where the surface tension of the oil film is released, thus allowing the dust particles to settle by gravity to the bottom of the reservoir. In its passage through the oil, media will be immersed for approximately one and a half hours.



Leaving the oil bath, the first stage becomes the second stage, after passing a compressed air line consisting of copper piping with a line of small holes drilled therein, from which air is blown through the medium to remove any unnecessary oil surplus. It then moves upwards in its oily-saturated state to entrap any finer particles of dust that may be left in the air stream.

The third stage serves to collect any residue of oil that may have a tendency to entrain in the air stream, after passing through the first and second stages, and also serves to entrap the finest dust particles that may remain. This stage proceeds downward into the reservoir, but does not pass through the oil bath, cleaning being accomplished by a second air line, similar to the first. After passing over this, it becomes the fourth stage, which acts as a preventive to further oil entrainment, and as the final stage in the removal of the fine dust particles.

MADE BY—*Staynew Filter Corp., Rochester, N. Y.*


Branch Duct to Private Office Space.
Automatic Damper
Main Damper
Access Door to Filter
Louvre and Screen
Upper Sash lowered but left free to operate.
Felt Strips to prevent draft.

Typical application of Dual Fan ventilating system

Degree-Days for March, 1936

IMPORTANT—Users of the Degree-Day are urged to refer to page 31 of this issue where HEATING & VENTILATING'S DEGREE-DAY COMPETITION is announced with prizes totalling $160 for articles relating to your use of the Degree-Day

	Albany, N. Y.	Atlanta, Ga.	Baltimore, Md.	Birmingham, Ala.	Boston, Mass.	Buffalo, N. Y.	Burlington, Vt.
Degree-days for March, 1936.....	708	257	500	202	718	929	882
Degree-days, Sept. 1, '35 to Mar. 31, '36	5766	3046	4280	2743	5320	6143	6928
Degree-days, Sept. 1, '34 to Mar. 31, '35	5793	2601	3839	2171	5405	5670	6926
Degree-days, Sept. 1 to Mar. 31, Normal	5847	2759	4162	2339	5230	5799	6690

	Chattanooga, Tenn.	Cheyenne, Wyo.	Chicago, Ill.	Cincinnati, Ohio	Cleveland, Ohio	Columbus, Ohio	Denver, Colo.
Degree-days for March, 1936.....	265	988	788	566	789	658	738
Degree-days, Sept. 1, '35 to Mar. 31, '36	3181	6429	6097	5036	5602	5336	5125
Degree-days, Sept. 1, '34 to Mar. 31, '35	2545	5398	5096	4046	4815	4394	4138
Degree-days, Sept. 1 to Mar. 31, Normal	2974	6173	5491	4344	5390	4816	5072

	Des Moines, Iowa	Detroit, Mich.	Dodge City, Kan.	El Paso, Tex.	Erie, Pa.	Evansville, Ind.	Fort Wayne, Ind.
Degree-days for March, 1936.....	734	849	524	221	842	469	757
Degree-days, Sept. 1, '35 to Mar. 31, '36	6699	6169	4861	2247	5787	4514	6065
Degree-days, Sept. 1, '34 to Mar. 31, '35	5349	5035	3724	2025	5150	3458	5106
Degree-days, Sept. 1 to Mar. 31, Normal	5825	5695	4646	2383	5400	3988	5330

	Grand Rapids, Mich.	Harrisburg, Pa.	Hartford, Conn.	Indianapolis, Ind.	Kansas City, Mo.	La Crosse, Wis.	Lincoln, Neb.
Degree-days for March, 1936.....	860	612	666	645	505	945	643
Degree-days, Sept. 1, '35 to Mar. 31, '36	6193	5054	5284	5499	5235	7384	6272
Degree-days, Sept. 1, '34 to Mar. 31, '35	5492	4637	5293	4395	428	6330	4807
Degree-days, Sept. 1 to Mar. 31, Normal	5827	4880	5303	4855	4966	6611	5547

	Little Rock, Ark.	Los Angeles, Calif.	Louisville, Ky.	Madison, Wis.	Memphis, Tenn.	Milwaukee, Wis.	Minneapolis, Minn.
Degree-days for March, 1936.....	226	203	469	923	243	883	1087
Degree-days, Sept. 1, '35 to Mar. 31, '36	3286	972	4543	7176	3394	6563	8097
Degree-days, Sept. 1, '34 to Mar. 31, '35	2484	1031	3556	6142	2495	5711	6676
Degree-days, Sept. 1 to Mar. 31, Normal	2733	1255	3916	6578	2854	6208	7045

	Nashville, Tenn.	New Haven, Conn.	New Orleans, La.	New York, N. Y.	Norfolk, Va.	Oklahoma City, Okla.	Omaha, Neb.
Degree-days for March, 1936.....	347	672	53	609	353	281	700
Degree-days, Sept. 1, '35 to Mar. 31, '36	3787	5115	1350	4689	3324	3714	6676
Degree-days, Sept. 1, '34 to Mar. 31, '35	2897	5026	929	4567	2883	2760	4934
Degree-days, Sept. 1 to Mar. 31, Normal	3398	5129	1023	4707	3103	3451	5633

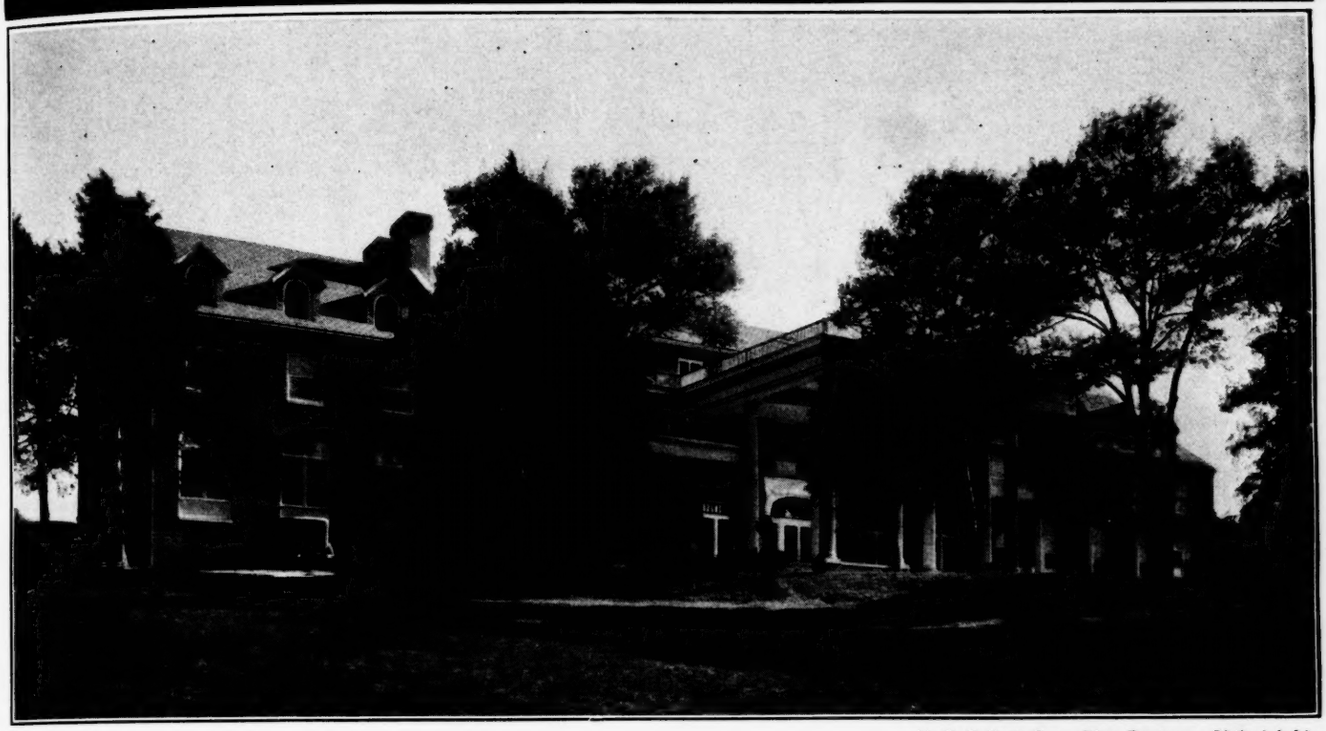
	Peoria, Ill.	Philadelphia, Pa.	Pittsburgh, Pa.	Portland, Me.	Portland, Ore.	Providence, R. I.	Reading, Pa.
Degree-days for March, 1936.....	717	519	648	830	610	662	588
Degree-days, Sept. 1, '35 to Mar. 31, '36	6119	4459	5079	5969	3944	5197	4897
Degree-days, Sept. 1, '34 to Mar. 31, '35	4921	4152	4357	6190	3386	5202	4561
Degree-days, Sept. 1 to Mar. 31, Normal	4535	4385	4734	6002	3732	5205	4876

	Richmond, Va.	Rochester, N. Y.	St. Louis, Mo.	Salt Lake City, Utah	San Francisco, Calif.	Scranton, Pa.	Seattle, Wash.
Degree-days for March, 1936.....	393	860	494	740	237	671	650
Degree-days, Sept. 1, '35 to Mar. 31, '36	3857	6007	4904	4979	1890	5603	3904
Degree-days, Sept. 1, '34 to Mar. 31, '35	3460	5614	3730	4515	1907	5313	3541
Degree-days, Sept. 1 to Mar. 31, Normal	3485	5854	4309	4866	2124	5445	3932

	Spokane, Wash.	Syracuse, N. Y.	Toledo, Ohio	Trenton, N. J.	Utica, N. Y.	Washington, D. C.	Wichita, Kan.
Degree-days for March, 1936.....	816	806	796	575	739	456	437
Degree-days, Sept. 1, '35 to Mar. 31, '36	5888	5974	6013	4879	6238	4281	4700
Degree-days, Sept. 1, '34 to Mar. 31, '35	5016	5676	5183	4617	5998	3875	3609
Degree-days, Sept. 1 to Mar. 31, Normal	5485	5984	5368	4450	5955	4253	4421

To obtain unit fuel consumption figures for any city shown above, multiply the number of degree-days by the following factors: for coal, 0.008; for oil, 0.00069; for gas, 0.096. Figures obtained will show coal consumption in pounds per square foot of radiator surface; oil consumption in gallons per square foot; gas consumption in cubic feet per square foot—all for the period covered by the number of degree-days. The figures assume the use of steam radiators emitting 240 B.t.u. per sq. ft. per hr., a system operation at 100% efficiency, and radiators calculated for maintaining 70° in zero weather. Heating values assumed for the fuels are 12,000 B.t.u. per lb. for coal; 140,000 B.t.u. per gal. for oil, and 1,000 B.t.u. per cu. ft. for gas. To correct for other heating values, efficiency and design conditions, follow the method explained in the "HEATING & VENTILATING Degree-day Handbook" or on H. & V.'s Reference Data Sheet Nos. 67 and 68. Degree-days as given above for a "normal" month or season are based on averages for a long period of years, ending about 1922. Averages covering different periods will disagree with the above figures slightly.

"Save $.50 per ton of coal" "Use only half as much coal"
"Do not have any more trouble with smoke and soot"



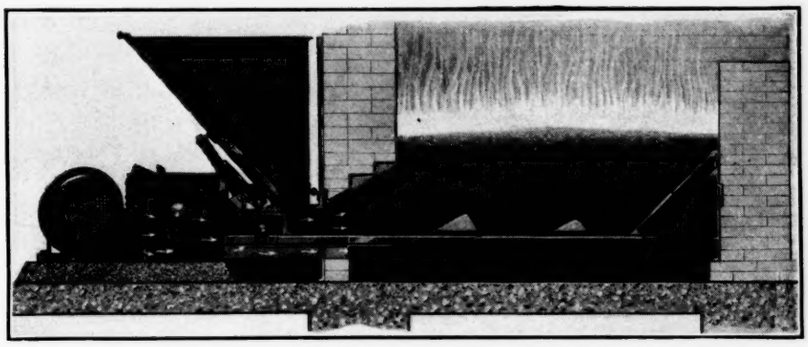
M. C. Gellett, Consulting Engineer, Philadelphia

Such were the results when a Detroit LoStoker was installed in the Mimslyn Hotel, Luray, Va.

The statements quoted above are taken from a report of Mr. John W. Mims, manager of the Mimslyn (Hotel of Distinction). A copy of the complete report will be sent to anyone interested.

This is typical of the performance not only of Detroit LoStokers but also of the largest Detroit Multiple Retort Stokers and all the intermediate sizes. There is a Detroit Stoker for virtually every load requirement and for burning a wide variety of fuels under all types of boilers.

Write for Bulletin 373



Sectional side elevation of Detroit LoStoker. Plunger Feed. Side Cleaning. Arrows indicate flow of air from the fan to all parts of the large active fuel bed.

DETROIT STOKER COMPANY

Sales Offices and Engineering Department:

Fifth Floor, General Motors Building, Detroit, Mich.

Works at Monroe, Mich.
District Offices in Principal Cities

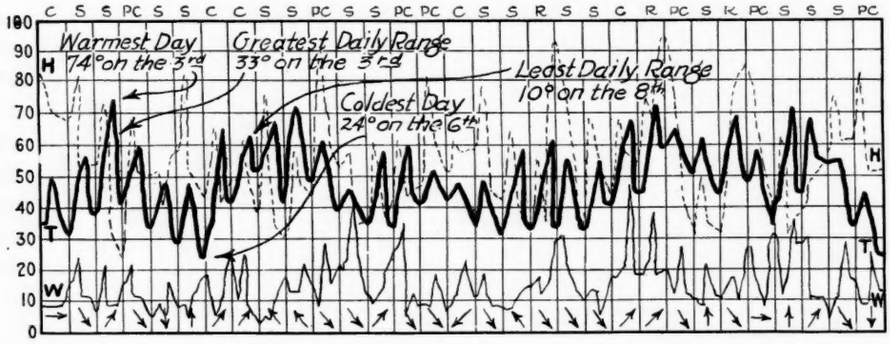
Built in Canada at London, Ontario

MODERNIZE AND ECONOMIZE WITH

DETROIT STOKERS

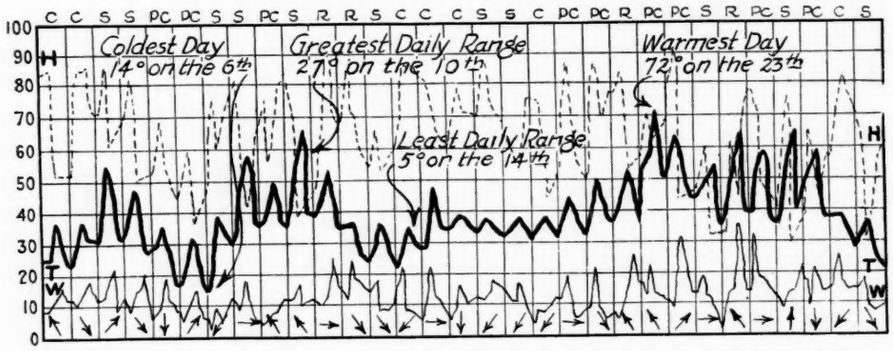
THE WEATHER FOR MARCH, 1936

Plotted from records compiled for HEATING & VENTILATING by the U.S. Weather Bureau. Heavy curves (T), dry bulb temperatures in deg. F.; dotted lines (H), per cent relative humidity from readings at 8 a.m., noon, and 8 p.m. Light lines (W), wind velocity in m.p.h. Arrows indicate prevailing wind directions, north being arrow pointing up, etc.; S—clear; PC—partly cloudy; C—cloudy; R—rain; Sn—snow.



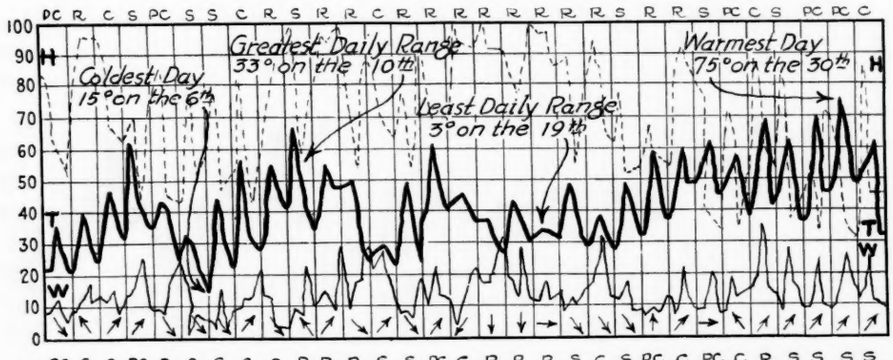
St. Louis

Mean temp. for month, 49.2°; aver. wind velocity, 13.6 m.p.h.; prevailing direction of wind, NW.



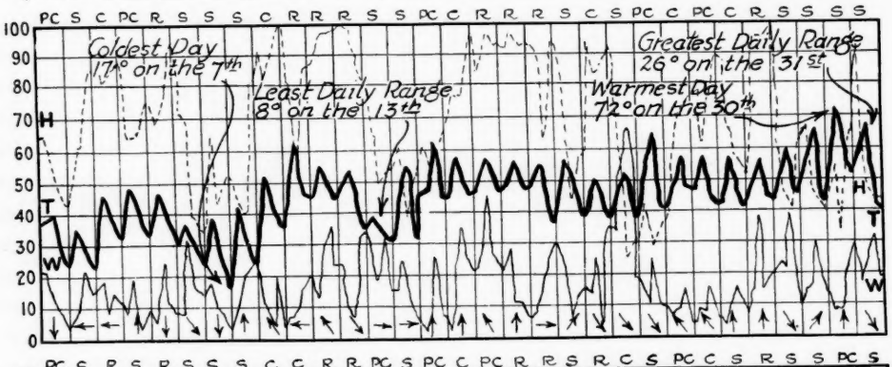
Chicago

Mean temp. for month, 39.6°; aver. wind velocity, 11.5 m.p.h.; prevailing direction of wind, W.



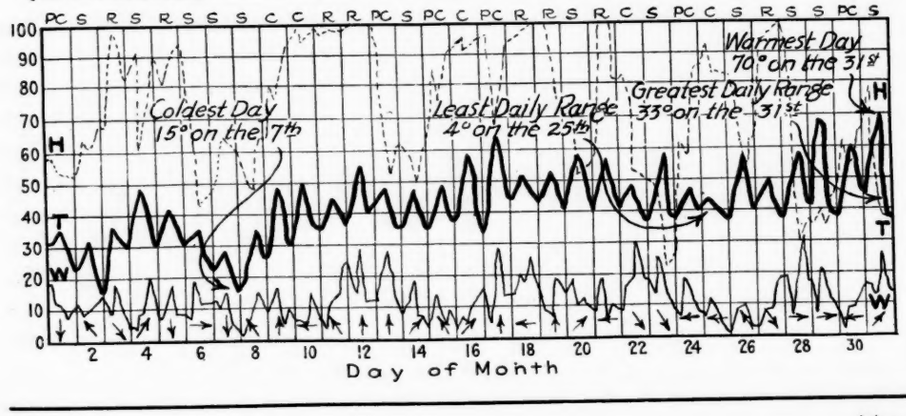
Pittsburgh

Mean temp. for month, 42.2°; aver. wind velocity, 12.0 m.p.h.; prevailing direction of wind, SW.



New York

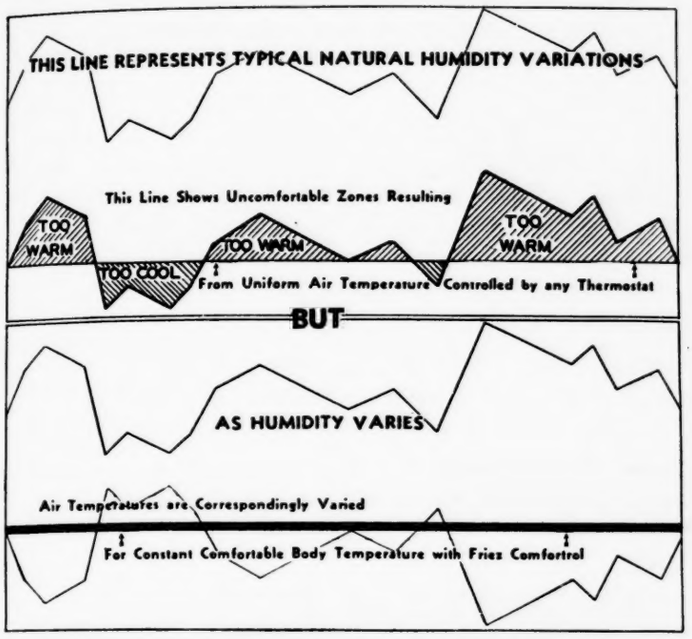
Mean temp. for month, 45.3°; aver. wind velocity, 14.7 m.p.h.; prevailing direction of wind, S.


Warmest Day
70° on the 31st
Coldest Day
15° on the 7th
Least Daily Range
4° on the 25th
Greatest Daily Range
33° on the 31st
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Day of Month

Boston

Mean temp. for month, 41.8°; aver. wind velocity, 10.7 m.p.h.; prevailing direction of wind, E.

THERMOSTAT or COMFORTROL ?


THIS LINE REPRESENTS TYPICAL NATURAL HUMIDITY VARIATIONS
This Line Shows Uncomfortable Zones Resulting
TOO WARM
TOO COOL
TOO WARM
TOO WARM
From Uniform Air Temperature Controlled by any Thermostat
BUT
AS HUMIDITY VARIES
Air Temperatures are Correspondingly Varied
For Constant Comfortable Body Temperature with Friez Comfortrol

JULIEN P. FRIEZ AND SONS, INC.
"THE MAKERS OF AMERICA'S WEATHER INSTRUMENTS"
BALTIMORE, MARYLAND

In your heating or cooling system you are now using a Thermostat. Have you ever raised the question: Can fixed temperature control by a thermostat produce comfortable body-sensitive temperature under constantly changing humidity conditions?

The charts we publish show:

1. Control of air temperature by a Thermostat necessarily produces zones of uncomfortable temperature, since uncontrolled humidity varies so much.

2. Control of temperature by a Friez Comfortrol produces a constant comfortable atmosphere, since it automatically varies air temperature to balance the uncontrolled rise and fall of humidity.

The Friez Comfortrol is a thermostat, but it contains also a humidity sensitive element which changes the temperature control point to deliver—in any heating or cooling system — comfortable effective temperature at all times.

The Heat Regulator with Built-In Dependability

Plain Model Type B-22

8-day Clock Model

Its reliability and reputation for accuracy and its great durability have made it outstanding with the trade. An exceptionally fine instrument made of the best materials; simple in construction and remarkably trouble-free.

MASTER HEAT REGULATOR

The complete Regulator includes Thermostat, Motor, Transformer, 30 ft. of cable, 18 ft. of Damper Chain, 4 Pulleys, Insulated Staples and Mounting Screws.

Type B-22 List Prices

8-day Clock Model (Complete)	$44.00
1-day Clock Model (Complete)	32.00
Plain Model (Complete)	22.50

THE WHITE MANUFACTURING CO., 2364 University Ave. St. Paul, Minn.

★ *New Beauty....*
★ *New Profits in*

MODINE CONVECTORS

By bringing an entirely new conception of beauty to convector design and application, Modine opens a new market with new profit opportunities to the contractor. Beautiful enclosures . . . Concealed, Recessed, Floor and Wall Cabinet types . . . wide selection of new interchangeable grilles—to harmonize with decorations of the finest homes.

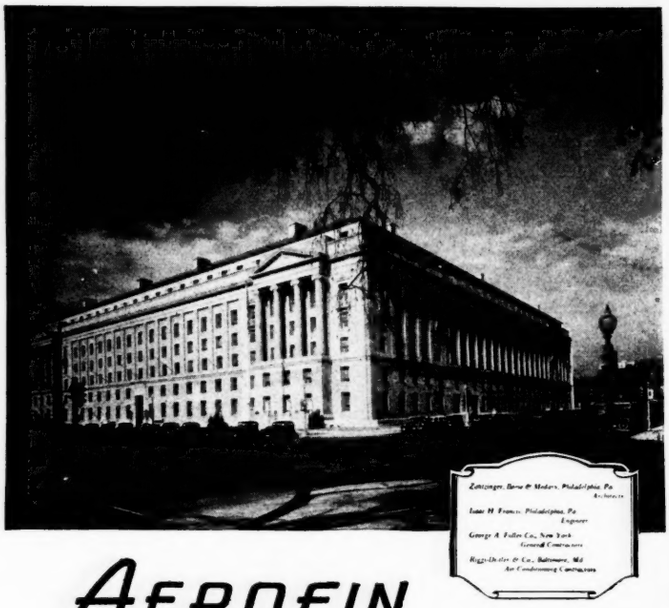
MODINE
MANUFACTURING COMPANY
1202 17th Street, Racine, Wis.

HEATING, COOLING AND AIR CONDITIONING FOR DOMESTIC, COMMERCIAL AND INDUSTRIAL APPLICATION

New Catalog gives complete details and specifications WRITE FOR IT

The New Home of the

U. S. Department of Justice



AEROFIN

FAN SYSTEM HEATING AND COOLING SURFACE

THE judicious selection of the best fan system heating surface, logically falls on Aerofin. Measured by the highest standards, Aerofin always lives up to specifications. This standardized light-weight fin-type surface has proved its high efficiency, dependability and long life in thousands of installations throughout the country.

For any job requiring forced fan heating or cooling, Aerofin is almost always the choice of experienced architects, consulting engineers and progressive heating contractors. If you do not know about Aerofin, investigate today—include it in the specifications for your next job. You will agree with others when they say that Aerofin gives them all they have wished for in a heating surface.

A complete line of equipment for heating and cooling is at your service. The home office in Newark or any of our branch offices will gladly send complete descriptive literature or render prompt personal and efficient technical co-operation. Simply write to the address below.

AEROFIN is sold only by Manufacturers of Nationally Advertised Fan System Apparatus. — List upon Request

AEROFIN CORPORATION
850 Frelinghuysen Avenue
Newark, N.J.
Chicago Detroit New York Philadelphia

11,000 Attend Oil Burner Show

(Concluded from page 42)

(those that said that perhaps they would buy, or hoped to buy). In relation to oil burners, the company found that at present there is a 30.2% buying intent compared to 15% last year, and an increasing desire to buy in 1936 of nearly 110%. This Mr. Beale interpreted as meaning that on this basis alone, if the industry fails to sell 350,000 units in 1936, it will have come far from hitting the expressed public interest in enjoying automatic heat.

When asked what type of oil heat would be considered those women showed a 41.9% interest in oil burners installed in their present heating plant, while 38.6% expressed interest in a new and complete oil burning unit. It is further interesting to know that when they named the factors which would most influence their decision to buy, 90% of the important ratings was centered among six leading factors. These were: economy, convenience, dependability, heating efficiency, reputation of the maker, reputation of the dealer.

W. C. Wood, secretary-treasurer of Timken Silent Automatic, Detroit, was the last speaker at the session, his subject being "Finance."

COMING EVENTS

MAY 12-16, 1936. FIRST WISCONSIN AIR CONDITIONING AND HEATING EXPOSITION, *Milwaukee Auditorium, Milwaukee, Wis.*

MAY 14-16, 1936. SPRING MEETING OF REFRIGERATING MACHINERY ASSOCIATION, *Hot Springs, Va.*

MAY 16, 1936. ANNUAL MEETING OF AIR CONDITIONING MANUFACTURERS' ASSOCIATION, *Hot Springs, Va.*

MAY 25-27, 1936. FORTY-SEVENTH ANNUAL CONVENTION OF HEATING, PIPING AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION. *Bellevue Stratford Hotel, Philadelphia, Pa.*

JUNE 9-11, 1936. SHORT COURSE IN COAL UTILIZATION, DEPARTMENT OF MINING AND METALLURGICAL ENGINEERING, *University of Illinois, Urbana, Ill.*

JUNE 16-19, 1936. NATIONAL DISTRICT HEATING ASSOCIATION CONVENTION AND EXHIBIT, *Pantlind Hotel, Grand Rapids, Mich.*

JUNE 17-18, 1936. NATIONAL WARM AIR HEATING AND AIR CONDITIONING ASSOCIATION CONVENTION, *Deshler-Wallick Hotel, Columbus, Ohio.*

JUNE 17-20, 1936. SEMI-ANNUAL MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, *Hotel Adolphus, Dallas, Tex.*

JUNE 22-24, 1936. SEMI-ANNUAL MEETING AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS AND AMERICAN SOCIETY OF REFRIGERATING ENGINEERS (JOINT MEETING), *Buck Hill Falls, Pa.*

OCTOBER 26-30, 1936. EIGHTEENTH ANNUAL CONVENTION OF AMERICAN GAS ASSOCIATION, *Atlantic City, N. J.*

NOVEMBER 30-DECEMBER 4, 1936. FIFTY-THIRD ANNUAL MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, *Engineering Societies Bldg., New York.*

NOVEMBER 30-DECEMBER 5, 1936. 12TH NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING, *Grand Central Palace, New York.*

NEW CATALOGS

(Unless otherwise indicated the publishers of catalogs will supply copies on request without charge.)

Acme Asbestos Covering & Flooring Co., Fulton and Elizabeth Sts., Chicago. New 1936 two-color catalog on insulations. Is in modern typography. Contains information and comment on the manufacture and uses of today's insulating materials. A complete line of pipe coverings, sheets, blocks, cements, general asbestos products, home insulation materials are covered.

Air Controls, Inc., (Division of The Cleveland Heater Co.), 1933 W. 114 St., Cleveland, Ohio. Four new publications devoted to the company's Rex-Airate line of equipment. Bulletin 66 is devoted to the company's attic fans for summer cooling, available in two models. Bulletins 64 and 65 describe the company's models R and S circulator ventilators, guarded fans which can be used for attic ventilation or for air circulation in other parts of the building. Bulletin 67 covers briefly the company's complete line described at more length than the other three bulletins. Each bulletin is standard size, four pages.

American District Steam Co., North Tonawanda, N. Y. An illustrated bulletin No. 35-76 on copper U-tube water heaters of the instantaneous or gravity recirculating types, in various sizes and capacities for heating or cooling water, oil, or other liquids.

Bethlehem Foundry & Machine Co., Bethlehem, Pa. A 16-page, 5½ x 8½ in. booklet describing the company's new line of Bethlehem-Doe oil burners.

Bodine Electric Co., 2264 W. Ohio St., Chicago. A summary of operating characteristics and recommended applications of Bodine fractional horsepower electric motors is given in the new four-page, two-color Bulletin 1020. Outlines the company's line of split-phase, capacitor, shaded pole, polyphase, and synchronous a.c. motors, as well as shunt and compound d.c. motors.

The Bristol Co., Waterbury, Conn. An 88-page thermometer catalog dealing with the theory and practice of modern-day thermometry. This catalog, No. 1250, covers liquid-filled, vapor-tension, and gas-filled recording, indicating, and controlling thermometers. It also describes a new small-bulb gas-filled thermometer.

Buffalo Forge Co., Buffalo, N. Y. Bulletin 3010 describing the company's "Breez-Air" attic ventilating fans available in 30, 36, and 42 in. sizes. Gives dimensional and capacity information, and shows photographs, together with general information. Standard size, four pages.

Carrier Engineering Corp., 850 Frelinghuysen Ave., Newark, N. J. A 9¾ x 12 in. piece of consumer literature beautifully arranged and covering the scope and variety of the company's service. Contains illustrations of the company's installations in hotels, apartments, and other buildings, and similar information to assist in selling the building owner.

Fedders Manufacturing Co., 57 Tonawanda St., Buffalo, N. Y. Bulletin 101. A standard size, 26-page catalog devoted to the company's blast heating coils for heating and air conditioning, and which are described as being cataloged on a package basis. Includes photographs and drawings of the coils, and detailed capacity tables for each model, giving face velocity, c.f.m., at inlet, outlet temperature, amount of condensate and B.t.u. per hour capacity. Other tables include factors for converting data from previous tables, which are based on 5 lb. steam pressure, to other steam pressures. Performance data, graphs, and problems with solution on selection of the surface are given.

Protectomotor Air Filters in Hayden Planetarium

Photo by Wurts Bros.

Years ago the American Museum of Natural History, New York, installed Protectomotor Panel Air Filters to prevent dust from ruining the priceless skeletons of whales, seals, elephants, and other exhibits in the Hall of Oceanic Life and the African Hall.

These Protectomotor Air Filters made good: so good that they were again chosen for their $800,000 Hayden Planetarium.

One time sales are common—but shrewd buyers do not purchase a second time unless the product makes good.

PROTECTOMOTOR
REG. U.S. PAT. OFF.
99 9/10 Per Cent EFFICIENT
AIR FILTERS

not only prevent dust and soot from ruining the costly exhibits in these buildings, but save large sums yearly for cleaning and redecorating.

Protectomotor Air Filters prevent 999 out of every 1000 particles of dust in the air from getting into buildings.

The Protectomotor is a dry filter. There is no viscous coating to be cleaned off and renewed frequently—no expense for labor and material used in recoating—no removal of panels, and no elaborate apparatus required for cleaning.

It takes about one-half minute per panel to remove all accumulations with a vacuum cleaner and cleaning is needed only about every two months.

Our catalog contains much interesting information. Write for a copy.

Staynew Filter Corporation
15 Leighton Avenue, Rochester, N. Y.

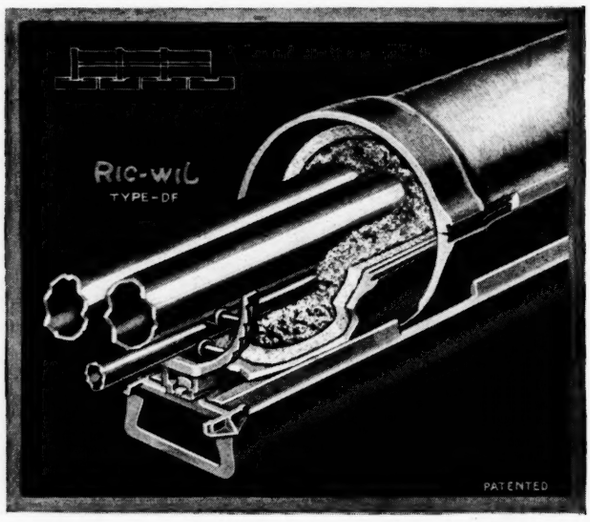
Many a Siren Has Put a Steam System on the Rocks . . .

NO, we don't want to sell you a mermaid—but thereby hangs a "tale." The siren in this case is not a steam whistle, nor yet a bewitching damsel—but the lure of *low-cost steam transmission.* In their anxiety to save on *first* cost, some owners and utilities are putting in, or have put in, underground lines on which the construction, drainage, and type of insulation leave little chance for the permanent economical conveyance of steam.

Ric-wiL Conduit, the correctly engineered system, will keep your steam lines tight, dry, and 90% (or more) efficient. It is made in a variety of weights and designs in both Tile and Cast Iron, to secure maximum results on any problem of underground steam transmission for heat or power. A choice of insulations, including the famous Ric-wiL waterproof asbestos Dry-paC. Ric-wiL Systems are complete, including installation instructions and engineering service drawings—and supervision on the job if desired. Write today for Bulletin.

The RIC-WIL Co., Union Trust Bldg., Cleveland, O.
New York San Francisco Chicago
Agents in principal cities

● Ric-wiL Dry-paC is pure asbestos insulation, which has certified conductivity of only .36 B.T.U. for low pressure.



REGISTERED IN U. S. PATENT OFFICE

RIC-WIL

CONDUIT SYSTEMS FOR UNDERGROUND STEAM PIPES

Hart & Cooley Mfg. Co., 61 W. Kinzie St., Chicago. Two useful publications; one, designated as Sizing Chart No. 3, shows the correct sizes of the company's forced air registers for various riser sizes, air volumes, air velocities, and designs. This information is contained on a sheet of cardboard measuring 5 x 8 in. In addition, the company has published the fifth edition of its Pocket Guide, a 3⅝ in. x 6⅝ in., 66-page catalog of the company's registers and grilles, damper regulator sets, furnace register sets, and other accessories. This is profusely illustrated and contains capacity and other price data for the equipment included.

The Independent Register Co., 3747 East 93 St., Cleveland, Ohio. No. 36 AC entitled Independent Air Conditioning Registers and Grilles. A standard size, 36-page catalog covering the company's complete line, and including net prices and capacities.

Ingersoll-Rand Co., Phillipsburg, N. J. A six-page bulletin, No. 2200, describing the Cameron Motorpump as used in air conditioning service. It illustrates these units in connection with air conditioning systems of several types.

Johnson Service Co., 1355 Washington Blvd., Chicago. A standard size, 24-page, attractively printed and bound catalog devoted to Johnson Zone Control systems. Color is elaborately used, and the illustrations and text are attractively laid out, and describe completely the design and operation details of the company's Duo-Stat.

The Ohio Electric Mfg. Co., 5900 Maurice Ave., Cleveland, Ohio. A 16-page, 12¼ x 9½ in. booklet entitled "Why Ohio Motors are Reliable." The booklet is profusely illustrated with views of the more important operations and the manufacture of the company's motors. It is especially notable for the beauty of the photography and typography. The booklet concludes with a summary of the 10 different types of motors made by the company and available in different speeds and electrical characteristics.

Peerless Ice Machine Co., 515 W. 35 St., Chicago. A standard size, loose-leaf, 56-page catalog devoted to the company's fin coils. Contains full structural details, photographs, dimensional and capacity tables for the wide range of various types of extended surface made by this company, including accessories also manufactured by Peerless.

Propellair, Inc., Springfield, Ohio. A standard size, four-page circular devoted to the company's line of circulating fans for use in stores, restaurants, and public buildings.

Richardson & Boynton Co., 244 Madison Ave., New York. An ingeniously arranged slide rule made of cardboard, 4½ x 8¾ in., and arranged for the solution of problems involving the sizing of winter air conditioning ducts and registers. After determining the equivalent amount of radiator surface for a room by the heat loss method, a table on the rule gives the so-called R & B factor. On the slide, opposite the R & B factor, can be found the volume of air and the area in square inches of round pipe necessary for that room for various register temperatures and air velocities. An additional table gives the diameter of pipes for the areas desired.

Spencer Heater Co., Williamsport, Pa. A complete line of catalogs and folders relating to the company's line of oil burning boilers and magazine feed boilers. All are designed to appeal to the homeowner and are attractively printed and arranged in color. One is entitled When Heating Your Home and is a 6 x 9 in., 26-page bulletin devoted to the Spencer automatic heater. A standard sized 8-page catalog, entitled Spencer Steel Oil Burning Boiler, illustrates, describes, and gives capacity and dimensional information.

●

Be sure to read the announcement on page 31 of HEATING & VENTILATING'S DEGREE-DAY COMPETITION. $160 in five cash awards are offered!

Heating Business in February 73.3% of 1929

(Concluded from page 60)

corresponding month of 1935, important gains being registered by oil burners, boiler-burner units, furnace-burner units, blowers, propeller fans, unit heaters, unit ventilators, steel boilers, stokers, non-ferrous indirect heating surface, non-ferrous and cast iron convectors.

In the table will also be found the figures for February on air conditioning equipment totalling over a million dollars for the month, but for which corresponding figures are not available for 1935. Of central air conditioning systems, comfort jobs totalled about 16 times as much as industrial installations.

WITH THE MANUFACTURERS

American District Steam Co., North Tonawanda, N. Y., has appointed the **Crane-O'Fallon Co.**, with branches in Denver, Grand Junction and Pueblo, Colo., Casper, Wyo., Albuquerque, N. M. and El Paso, Tex., as representative for the central mountain district.

E. E. Bangs

American Gas Products Corp., New York, has placed **Edward E. Bangs,** for the past several years with the Bryant Heater Mfg. Co., in charge of its Boston territory. This territory extends from Norwalk, Conn., through Maine. Mr. Bangs was formerly connected with the Maine Central Railroad, Lynn Gas and Electric Company, and had his own heating business from 1920 to 1925.

American Radiator Co., New York, has formed an **Automatic Coal Burner Div.**, with **W. B. Hughes,** formerly with the Iron Fireman Manufacturing Co., in charge. The new division will be a part of the Allied Products Division. While with Iron Fireman, Mr. Hughes held successively the position of district sales manager in the New York metropolitan area, engineering service manager of the Cleveland plant, and assistant general sales manager. Prior to his association with Iron Fireman, he was for several years in the heating and ventilating business in Portland.

G. L. Erwin, Jr.

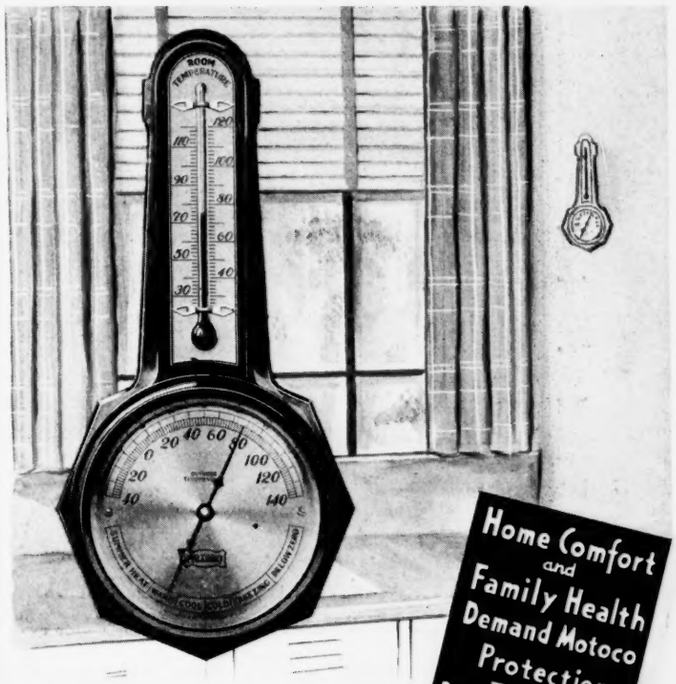
Crane Co., Chicago, has appointed **George L. Erwin, Jr.,** as assistant to P. R. Mork, vice-president in charge of sales. Mr. Erwin, a graduate of Cornell University, was formerly general sales manager of Kearney & Trecker Corp., Milwaukee. In his newly-created position he will develop sales and market research activities. He has had wide experience in sales and advertising.

Foster Wheeler Corp., 165 Broadway, New York, and **General Regulator Corp.**, announce that a consolidation of the sales departments of the two companies has been completed. Distribution for General Regulator will be made hereafter through the branch offices and agents of Foster Wheeler Corp. Sales headquarters of the General Regulator Corp. will be at the general offices of Foster Wheeler Corp. **C. J. King,** who has been identified with the General Regulator Corp. since it was organized, will direct this work from New York as in the past.

Frick Co., Inc., Waynesboro, Pa., announces that its Cleveland office has been moved to 2485 Traymore Rd. from 3420 Clarendon Rd. **L. O. Trubshaw** is branch manager.

The MOTOCO

INDOOR and OUTDOOR TEMPERATURE at a GLANCE —



MOTOCO for your Home and Office

MOTOCO located at a convenient place in your home or office not only indicates both the Indoor and Outdoor temperatures at a glance, but also points out the difference between the two. Consider what this means, because of its effect on both your comfort and your health, as the difference in the Indoor and Outdoor temperatures is of vital importance.

Indoor temperature to be healthful must be maintained within definite limits. A sudden rise or fall in outside temperature has a direct influence on home heating and ventilation, which cannot be properly regulated without an exact knowledge of the outside temperature changes. MOTOCO keeps you informed at all hours of the day or night.

Literature will be forwarded upon receiving your request.

MOTOCO has an artistic silver finish dial and bevel crystal. It may be obtained in the following colors: maroon, walnut, black, green and ivory.

THE ELECTRIC AUTO-LITE COMPANY
MOTOMETER GAUGE & EQUIPMENT DIVISION
LA CROSSE, WISCONSIN

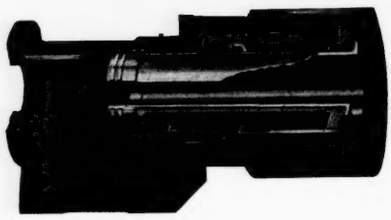
Check these Points —then you will say **DAVIS PRESSURE REGULATORS!**

1. *No Springs.* Pressure is balanced by weight, Always constant, never grows weak.
2. *No Diaphragm.* No delicate parts to require bothersome adjustment and maintenance.
3. *No Gaskets, No Packing.* The Davis construction eliminates the common causes for leaks and friction.
4. *Visible Action.* You see the valve act automatically; you can test it yourself instantly.
5. *Constant Range.* The Davis patented inner valve gives accurate regulation regardless of flow. Oil cushioning smooths out pressure fluctuations and prevents chattering.

Get Davis' Recommendations for all of your valve requirements.

DAVIS REGULATOR COMPANY
2553 S. Washtenaw Avenue, Chicago, Illinois

ADSCO PISTON RING JOINT



Can Be Repacked Under Full Operating Pressure

Uninterrupted service is assured by the adaptation of the piston-ring principle to expansion joints. The stuffing box can be *unpacked* and *repacked* under full operating pressure. The country's leading engineers hail this as an outstanding achievement.

Ordinary maintenance on these long traverse Expansion Joints (4, 8 and 12 inches) may be conducted at any convenient time.

Write us today for Bulletin No. 35-15 giving complete information regarding other important features of this outstanding joint.

AMERICAN DISTRICT STEAM COMPANY
NORTH TONAWANDA N.Y.
OVER FIFTY YEARS IN BUSINESS

Frigidaire Corp., Dayton, has announced the following appointments: **Roy E. Smithson** to be manager, commercial products sales division; **Lowell McCutcheon** to be manager, wholesale division; **Virgil Hetzel** to be manager, installation and service division.

Mr. Smithson fills a newly-created post made necessary by the separation of commercial and air conditioning products sales activities through the formation of Delco-Frigidaire Conditioning Corp. He has been associated with Frigidaire and its predecessor companies for nearly twenty years.

Mr. McCutcheon came up through the sales ranks in New York to general sales manager. Early in 1932, he was transferred to Dayton as commercial sales manager, then went to Chicago as district manager. Two years ago, he was returned to Dayton headquarters as manager of the railway sales department, which he leaves to take over the management of the wholesale division. Mr. Hetzel has been with General Motors Corp. for 17 years.

Lowell McCutcheon

The Hoffman Specialty Co., Waterbury, Conn., has appointed **Frank J. Weber** as factory representative in the Buffalo territory. He succeeds Ralph Cressy, resigned. Mr. Weber formerly represented the company in Detroit.

Kelvinator Corp., Detroit, in order to place before the public the latest findings of modern temperature engineering, has established **The Temperature Research Foundation,** at 80 Broadway, New York. The Foundation will act as a clearing house for facts and data on heating, food preparation and preservation, and air conditioning. **Edward Heitman,** Kelvinator's chief engineer, is director.

Lamneck Products, Inc., Columbus, Ohio, announces that **Carl Johnson,** formerly vice-president and general manager of Champion Furnace Pipe Co., Peoria, Ill., has joined Lamneck's organization. He will specialize in special development work with the jobbing trade. The addition of Mr. Johnson is another step in line with the company's policy to build a complete service organization which will work closely with the jobbing trade, assisting the sales organizations of jobbers in the use of prefabricated ducts and fittings.

Jas. P. Marsh Corp., Chicago, has appointed **Chas. M. Bailey Co., Inc.,** 342 Towne Ave., Los Angeles, as representative in the Southern California territory. **A. W. Merrill** is now associated with the Bailey organization.

The Mercoid Corp., Chicago, has opened a branch office and warehouse in Boston in charge of **A. W. Barr.** The branch will be located at 25 Ivy St., corner of Park Ave., near Beacon St.

Nelson Co., Manufacturing Div., 2604 Fourth Ave., Detroit, has taken over the manufacturing rights, and in addition will distribute nationally the Bertossa power heater and allied air conditioning equipment, made in eight sizes from 80,000 to 2,800,000 B.t.u. per hr. The units are available for burning gas, oil, or coal. The company also announces that **Ed. Root** has joined its staff of heating and air conditioning engineers. Mr. Root was formerly connected with the Detroit Safety Furnace Co.

Penn Electric Switch Co., Des Moines, Iowa, has named **R. L. Deppmann Co.,** 905 Holden Ave., Detroit, as distributor of its controls for heating, serving the Detroit area. The **W. C. Du Comb Co.,** 6335 Palmer Ave., Detroit, will continue as distributor for refrigeration and air conditioning controls. Penn Electric Switch Co. will still maintain direct representation in the Detroit area through its Detroit office at 600 Michigan Theater Bldg., in charge of Paul Penn.

H. A. Thrush & Co., Peru, Ind., has appointed **Claude A. Olson,** 1015 Hawthorne St., Fort Worth, Tex., as southwestern representative covering Texas and Oklahoma.

Comfort Cooling . . . . TO INCREASE PROFITS

Modine Cooling Coils increase diners' comfort . . . appetite . . . and checks.

Modine Unit Coolers make hot-weather shopping a pleasure and increase store sales.

Stores, shops, restaurants, theatres, taverns, etc., recognize comfort cooling as a sound investment offering high returns in increased summer patronage.

When you sell Modine Cooling Equipment you are selling superior design, construction and materials . . . backed by the extensive facilities, experience and organization of a pioneer manufacturer with a financial rating of over a million dollars. And Modine field representatives . . . trained experts in all phases of cooling . . . render the contractor engineering and selling assistance unmatched in the industry.

Modine Unit Coolers and Cooling Coils not only lower the air temperature . . . they extract excessive moisture from the air, thereby reducing humidity which is responsible for much of the discomfort of hot weather.

Because Modine Unit Coolers involve no ductwork or change in building construction but are easily and economically installed, they are excellently adapted to modernization.

Modine Cooling Coils, with their increased heat absorption capacity and ability to cool a large volume of air, are constantly being recommended by architects and engineers for commercial cooling.

Both Modine Unit Coolers and Modine Cooling Coils (Cold Water Type) combine heating and cooling in a single unit. A wide line of other Modine cooling products is also available. *Write for detailed information.*

MODINE MANUFACTURING COMPANY, 1202-17th ST., RACINE, WIS.

Cooling, Air Conditioning, and Heating Equipment for Commercial, Industrial and Domestic Application